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ABSTRACT

This module is the first of nine modules in the competency-based Missouri Auto Mechanics Curriculum Guide. Seven units cover: automotive chemicals and their use; basic automotive hand tools; specialty tools, fasteners, and precision measuring tools; power tools and shop equipment; safety clothing and equipment; shop operation; and careers in auto mechanics. Introductory materials include a competency profile and cross-reference table that shows how competencies relate to instructional objectives and test items. Each unit consists of some or all of these components: objective sheet with unit and specific objectives; cover sheet with content outline and list of references; information sheets; assignment sheets; and unit test with answer key. (YLB)

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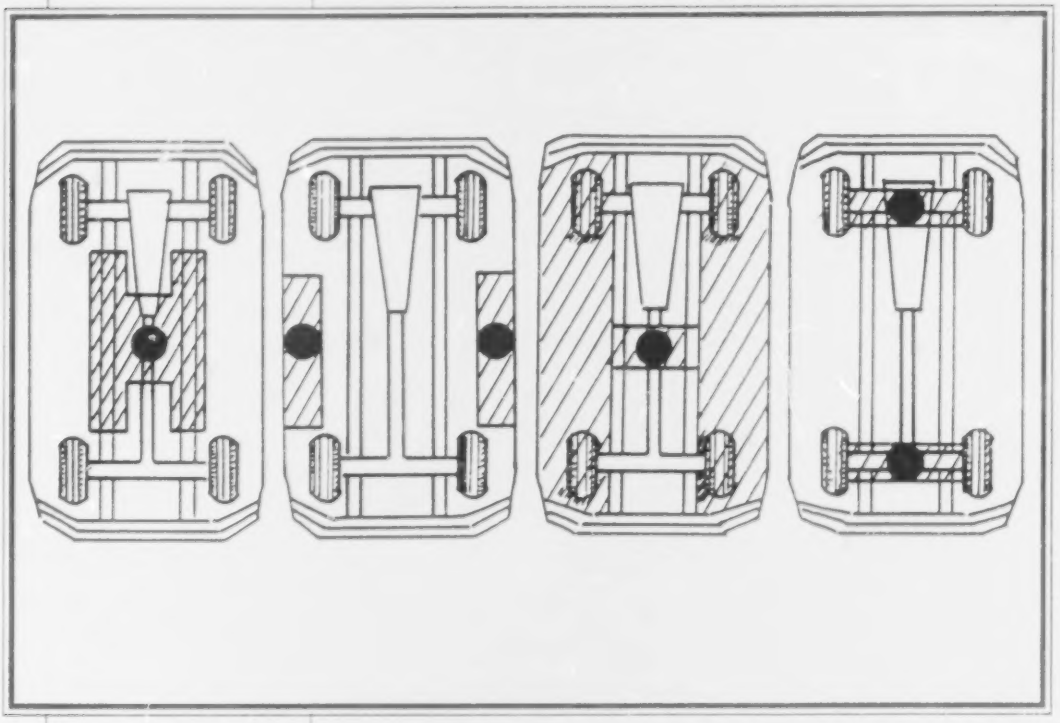
70-1801-I
Instructor's Guide

Auto Mechanics
Curriculum Guide



Module 1

Introduction to Auto Mechanics

Produced by
Instructional Materials Laboratory
In cooperation with the Dept. of
Elementary and Secondary
Education

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MODULES INCLUDED IN THE AUTO MECHANICS CURRICULUM GUIDE

INTRODUCTION TO AUTO MECHANICS
ELECTRICAL SYSTEMS
ENGINE PERFORMANCE
ENGINE REPAIR
SUSPENSION AND STEERING
BRAKES
MANUAL DRIVE TRAIN AND AXLES
AUTOMATIC TRANSMISSION AND TRANSAXLES
HEATING AND AIR CONDITIONING

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AUTO MECHANICS CURRICULUM

MODULE 1: INTRODUCTION TO AUTO MECHANICS

INSTRUCTOR'S GUIDE

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FOREWORD

Once again, we are indebted to the teachers and administrators who provide their time, efforts, and professionalism to develop curriculum for trade, technical, and industrial education programs. The Introduction to Auto Mechanics module (the first of nine modules to make up the Missouri Auto Mechanics Curriculum Guide) is an outstanding example of what can be accomplished when the right people with the right attitude work together. The curriculum writers and subject matter experts who worked on this guide are to be commended for a job well done.

The module's format has been developed for competency-based teaching and testing. Evaluation instruments within the guide can be managed with the Vocational Administrative Management System (VAMS). All major components of the module have been keyed to the Missouri Auto Mechanics Competency Profile, which was developed by industry and education professionals within Missouri.

Special appreciation is given to Robert Colesworthy, the module's writer. Special appreciation is also given to Fred Smith, who served as a technical adviser during production of the module.

The format and curriculum management system found in this module may be new to many vocational educators. However, we are confident that, when used as designed, this module will allow for a more productive and rewarding educational experience for both teacher and student. Any future auto mechanics curriculum modifications will begin with the Missouri Auto Mechanics Curriculum Guide. Auto mechanics, like many technical fields, is undergoing constant and considerable change. We will annually evaluate the need to update this guide on a module-by-module basis. Your suggestions regarding areas for improvement are both encouraged and appreciated.

Judith Moore, Supervisor
Industrial Education
Department of Elementary and Secondary Education

Charles Waibel, Director
Industrial Education
Department of Elementary and Secondary Education

ACKNOWLEDGEMENTS

Introduction to Auto Mechanics is the first of nine modules that make up the Missouri Auto Mechanics Curriculum Guide. Produced by the Instructional Materials Laboratory (IML), the guide represents a continuing commitment to Missouri's Vocational Instructional Management System (VIMS). All modules in the guide are based on the Missouri Auto Mechanics Competency Profile, which in turn is based on and cross-referenced to the ASE task list. For years ASE has set the professional standards for automotive technicians. Therefore, a strong ASE orientation makes the guide an effective tool for preparing students to enter the technologically advanced field of auto mechanics.

IML extends special recognition to Robert Colesworthy, the writer of Introduction to Auto Mechanics. Mr. Colesworthy's years of experience as both a teacher and an automotive technician is evident throughout his work. Special recognition also goes to Fred Smith, who contributed heavily to the module as a technical adviser. Mr. Smith's attention to technical detail proved invaluable throughout the module's development.

IML gratefully acknowledges the important contribution of the advisory committee, which, among other tasks, developed the competency profile for the guide. The advisory committee members are listed below:

Advisory Committee Members

Charles Waibel and Judith Moore, Division of Vocational and Adult Education, Department of Elementary and Secondary Education, Jefferson City, Mo.
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Wayne Sweatt, Lake AVTS, Camdenton, Mo.
Darwin Kraenow, Linn Technical College, Linn, Mo.

IML also acknowledges the fieldtesters, who worked to ensure that the Introduction to Auto Mechanics module was developed into an effective and practical teaching tool. The fieldtesters are listed below:

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Robert Barbarick, Four Rivers AVTS, Washington, Mo.
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Ted Scarbrough, Arcadia Valley AVTS, Ironton, Mo.
Wayne Sweatt, Lake AVTS, Camdenton, Mo.

IML would like to express special appreciation to Auffenberg's Eldon Ford-Mercury in Eldon, Mo. for providing access to their technical library.

The support and contributions of the following IML staff members were instrumental to the development of this module:

Instructional Materials Laboratory Staff

Harley Schlichting, Director
Arnon Herd, Associate Director
Phyllis Miller, Assistant Director
Dan Stapleton, Assistant Director
Sharon Dyer, Graphic Artist II
Lori Holliday, Word Processor Operator III
Wei Li, Graduate Assistant

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HOW TO USE THE MISSOURI AUTO MECHANICS CURRICULUM GUIDE

The Introduction to Auto Mechanics module of the Missouri Auto Mechanics Curriculum Guide contains the following major components: (1) a competency profile, (2) objective sheets, (3) information sheets, (4) assignment sheets, (5) tests, and (6) a cross-reference table. Below is a discussion of the design of these components.

(NOTE: The Introduction to Auto Mechanics module deals almost exclusively with cognitive tasks; therefore, the competency evaluation system used in the Introduction module is quiet different from the system that is consistently used throughout the other modules. If the instructor reads the below material and follows the instructions found at the end of tests and assignment sheets in the Introduction to Auto Mechanics module, the evaluation system for the module should be clear.)

MISSOURI COMPETENCY PROFILE

The competency profile identifies 144 basic auto mechanics competencies. The profile divides the competencies into nine general areas, each of which serves as the basis for individual modules of instruction (such as the Introduction to Auto Mechanics module). The competency profile further divides these general areas into duty bands, each of which is identified by a capital letter. An example of a duty band in the Introduction to Auto Mechanics module would be "Safety." Under each duty band are listed several competencies, each of which is identified by an Arabic numeral. Note the below excerpt from the competency profile:

3	2	1	N	A. Safety	ASE Task(s)
				1. Identify the safe use of chemicals	NONE
				2. Identify the safe use of hand tools	NONE
				3. Identify the safe use of power tools	NONE
				4. Identify the safe use of protective clothing and equipment	NONE
				5. Identify the safe use of fire protection equipment	NONE
				6. Identify the safe use of shop equipment	NONE
				7. Follow Environmental Protection Agency (EPA) and Occupational Safety and Health Act (OSHA) regulations	NONE

In this excerpt, the duty band "Safety" is identified by the letter "A." The competency "Identify the safe use of chemicals" falls under Duty Band A and is identified by the Arabic numeral "1." Throughout the Introduction to Auto Mechanics module, therefore, the competency "Identify the safe use of chemicals" will be referred to as Competency A1. Other competencies under Duty Band A are, for example, A2,"Identify the safe use of hand tools," and A3, "Identify the safe use of power tools."

In all models except Introduction to Auto Mechanics, one or more ASE tasks are listed to the right side of each competency on the profile. Because the Introduction to Auto Mechanics module covers only general information, no ASE tasks are addressed and none, therefore, are listed.

(**NOTE:** The term "cross-reference table" will appear throughout the rest of this discussion. A cross-reference table is a chart that shows precisely how objectives, assignment sheets, and test questions are related to individual competencies. The cross-reference table will be discussed later in more detail.)

INFORMATION SHEETS

The information sheets (or information outline) present the student with important facts and concepts relating to basic automotive technology and service procedures. The information sheets also explain why a procedure is necessary and why it must be performed in a certain manner. Though not intended to be as comprehensive as a textbook, the information sheets provide a good source of information to which the student can refer outside of class. Perhaps the information sheets can best be thought of as a thorough set of notes accompanying the instructor's classroom lecture.

ASSIGNMENT SHEETS

In the Introduction to Auto Mechanics module there are only four assignment sheets; three are found in Unit VI and one is found in Unit III. The assignment sheet in Unit III merely provides practice for reading a micrometer and evaluates no competencies. The assignment sheets in Unit VI cover paper pencil activities (such as filling out repair orders) that relate to specific competencies and are used to evaluate these competencies. At the end of the assignment sheets in Unit VI, a note like the one below explains which competency is evaluated and provides a scale for the evaluation.

> (NOTE: Use the spaces below to rate the student's performance of the above assignment sheet tasks by giving him or her a 3 to indicate the student has mastered the tasks; a 2 to indicate that the student needs supervision to perform the tasks; a 1 to indicate that the student has not mastered the tasks; or N to indicate that the student lacked the experience or knowledge to perform the tasks. The student's rating will serve as his or her final evaluation for Competency B3.)
>
> ___ 3 ___ 2 ___ 1 ___ N

Assignment Sheet 1, Lesson 1, Unit VI (AS1-L1-UVI) serves as the final evaluation for Competency B1. Assignment Sheet 2, Lesson 1, Unit VI (AS2-L1-UVI) serves as the final evaluation for Competency B2. Assignment Sheet 1, Lesson 2, Unit VI (AS1-L2-UVI) serves as the final evaluation for Competency B3.

(NOTE: In no other modules except Introduction to Auto Mechanics are assignment sheets used to evaluate competencies directly. In all other modules, only job sheets directly evaluate competencies. See the introduction to the other modules for a more detailed explanation of evaluation procedures.)

UNIT TESTS

Unit tests cover information relating to specific competencies. In the Introduction to Auto Mechanics module, the student receives an evaluation for a specific competency based upon his or her performance on the test or a specific part of the test. A note at the end of the test, or part of a test, provides the teacher with instructions on how to evaluate the student on a specific competency. Below is an example of the note for Unit I:

> (NOTE: The student's score on the Unit I Test will be his or her final evaluation for Competency A1. A score between ____ and ____ = 3; a score between ____ and ____ = 2; a sore between ____ and ____ = 1, and a score lower than ____ = N.)

As the note indicates, the student's evaluation is based upon the test score the student receives. If an evaluation of a student's competency was based on merely a part of a test, then a similar note would appear at the end of the appropriate test part. Also note that Competency A2 is evaluated based upon an average of both the Unit II and Unit III test scores; a note and the instructions at the end of the Unit III test explain how to determine the student's final evaluation.

As was indicated in the section on assignment sheets above, the numbers "3," "2," "1" and the letter "N" are used to evaluate the student's performance of a specific competency. Once again, the meaning of the numbers and the letter N is as follows:

3 = Mastery - can work independently with no supervision
2 = Requires Supervision - can perform job completely with limited supervision
1 = Not Mastered - requires instruction and close supervision
N = No Exposure - no experience or knowledge in this area

OBJECTIVE SHEETS

The first page of each unit in the guide is an objective sheet, which states the unit's general and specific objectives. Below is a partial reproduction of the objective sheet for Unit I of the Introduction to Auto Mechanics module:

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT I: AUTOMOTIVE CHEMICALS AND THEIR USE

UNIT OBJECTIVE

After completing this unit, the student will be able to identify chemicals commonly used in the automotive shop as well as safety precautions for using these chemicals. The student will demonstrate mastery of the material by achieving a score of _____ on the unit test.

SPECIFIC OBJECTIVES

After completing the lessons in this unit, the student should be able to:

Lesson 1.	I.	Identify the different types of solvents used in the auto mechanics field (Competency A1, Unit I Test).
	II.	Identify the hazards and precautions in the use of automotive solvents (Competency A1, Unit I Test).
Lesson 2.	I.	Identify the different types of automotive soaps and cleaning solutions as well as their purposes and correct use (Competency A1, Unit I Test).
Lesson 3.	I.	Identify the different types and purposes of oils, greases, and specialty additives (Competency A1, Unit I Test).
	II.	Identify the hazards and precautions in the use, handling, and storage of oils, greases, and specialty additives (Competency A1, Unit I Test).
	III.	Identify the uses of various automotive specialty chemicals (Competency A1, Unit I Test).
	IV.	Identify the general rules for the use of automotive chemicals (Competency A1, Unit I Test).
Lesson 4.	I.	Identify the gasses encountered in the auto mechanics field and the hazards they present (Competency A1, Unit I Test).
	II.	Identify the hazards and control of asbestos dust (Competency A1, Unit I Test)

ASE TASKS COVERED IN THIS UNIT

I. Only material that is preliminary to ASE tasks appears in this unit; therefore, no ASE tasks are covered directly.

Notice that the specific objectives are designated by Roman numerals. Also notice that the competency (or competencies) to which each objective relates is listed in parentheses behind each objective. Also listed in parentheses is the method by which the student's ability to perform the objective is evaluated.

CROSS-REFERENCE TABLE

The cross-reference table can quickly reveal how competencies relate to instructional objectives and test items. Note the following excerpt from the Introduction to Auto Mechanics module cross-reference table:

MODULE: INTRODUCTION TO AUTO MECHANICS
CROSS-REFERENCE TABLE OF INSTRUCTIONAL MATERIALS

Competency	Instructional Objective	Assignment Sheet	Test Item	Notes
A1	UI-L1-I, UI-L1-II, UI-L2-I, UI-L3-I, UI-L3-II, UI-L3-III, UI-L3-IV, UI-L4-I, UI-L4-II		UI 1-40	

The above excerpt lists all the instructional objectives in the module that cover Competency A1. The cross-reference table also indicates the test questions that cover Competency A1. Notice that there is also a space to indicate what assignment sheets cover the competency; however, there are no assignment sheets related to A1. By looking at the cross-reference table, the instructor can, therefore, quickly determine what test questions a student needs to answer and what assignment sheets, if any, a student needs to perform before receiving a final evaluation for a particular competency.

PACKAGING OF THE AUTO MECHANICS CURRICULUM GUIDE

Each module in the Auto Mechanics Curriculum Guide is packaged in three components: an instructor's guide, a student reference, and student work sheets. The instructor's guide includes the following items, all of which are color coded:

Cross-reference table (color-coded white)
Objective sheets (color-coded white)
Table of contents, references, notes to the instructor, answer sheets for tests (color-coded pink)
Information sheets (color-coded green)
Assignment sheets (color-coded [illegible])
Unit tests (color-coded yellow)

The student reference contains copies of the objective sheets and information sheets from the instructor's guide. The student work sheets include consumable items from the instructor's guide, such as assignment sheets and unit tests. For convenience, the page numbers of the items in the student reference and in the work sheets are the same as those in the instructor's guide; therefore, page numbers in the student reference and work sheets are not consecutive. All student reference pages and work sheet pages are white.

Competency profiles for the guide are packaged in groups of ten along with a copy of the ASE task list.

MODULE: INTRODUCTION TO AUTO MECHANICS
CROSS-REFERENCE TABLE OF INSTRUCTIONAL MATERIALS

Competency	Instructional Objective	Assignment Sheet	Test Item	Notes
A1	UI-L1-I, UI-L1-II, UI-L2-I, UI-L3-I, UI-L3-II, UI-L3-III, UI-L3-IV, UI-L4-I, UI-L4-II		UI 1-40	
A2	UII-L1-I, UII-L1-II, UII-L1-III, UII-L2-I, UII-L2-II, UII-L3-I, UII-L3-II; UIII-L1-I, UIII-L2-I, UIII-L2-II, UIII-L2-III, UIII-L2-IV, UIII-L3-I, UIII-L3-II	AS1-L3-UIII	UII 1-32 UIII 1-48	
A3	UIV-L1-I, UIV-L1-II		UIV 1-26	
A4	UV-L1-I, UV-L1-II, UV-L1-III		UVI 1-16	
A5	UV-L2-I, UV-L2-II, UV-L2-III		UV 17-24	
A6	UIV-L2-I		UIV 27-34	
A7	UV-L3-I, UV-L3-II		UV 25-34	
B1	UVI-L1-I, UVI-L1-II, UVI-L1-IV	AS2-L1-UVI	UVI 1-12	
B2	UVI-L1-III	AS1-L1-UVI	UVI 13-19	
B3	UVI-L2-I	AS1-L2-UVI		
B4	UVI-L3-I, UVI-L3-II		UVI 20-30	
C1	UVII-L1-I		UVII 1-10	
C2	UVII-L2-I, UVII-L2-II, UVII-L2-III, UVII-L2-IV, UVII-L2-V, UVII-L2-VI		UVII 11-20	

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT I: AUTOMOTIVE CHEMICALS AND THEIR USE

UNIT OBJECTIVE

After completing this unit, the student will be able to identify chemicals commonly used in the automotive shop as well as safety precautions for using these chemicals. The student will demonstrate mastery of the material by achieving a score of _____ on the unit test.

SPECIFIC OBJECTIVES

After completing the lessons in this unit, the student should be able to:

Lesson 1.

I. Identify the different types of solvents used in the auto mechanics field (Competency A1, Unit I Test).

II. Identify the hazards and precautions in the use of automotive solvents (Competency A1, Unit I Test).

Lesson 2.

I. Identify the different types of automotive soaps and cleaning solutions as well as their purposes and correct use (Competency A1, Unit I Test).

Lesson 3.

I. Identify the different types and purposes of oils, greases, and specialty additives (Competency A1, Unit I Test).

II. Identify the hazards and precautions in the use, handling, and storage of oils, greases, and specialty additives (Competency A1, Unit I Test).

III. Identify the uses of various automotive specialty chemicals (Competency A1, Unit I Test).

IV. Identify the general rules for the use of automotive chemicals (Competency A1, Unit I Test).

Lesson 4.

I. Identify the gasses encountered in the auto mechanics field and the hazards they present (Competency A1, Unit I Test).

II. Identify the hazards and control of asbestos dust (Competency A1, Unit I Test).

ASE TASKS COVERED IN THIS UNIT

I. Only material that is preliminary to ASE tasks appears in this unit; therefore, no ASE tasks are covered directly.

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT I: AUTOMOTIVE CHEMICALS AND THEIR USE

CONTENTS OF THIS UNIT

A. Objective sheet

B. References

C. Lesson plans

1. Lesson 1: USING SOLVENTS

   a. Information outline

2. Lesson 2: USING SOAPS AND CLEANING SOLUTIONS

   a. Information outline

3. Lesson 3: USING OIL AND GREASE

   a. Information outline

4. Lesson 4: GASSES AND DUST IN THE AUTOMOTIVE REPAIR FIELD

   a. Information outline

D. Unit test

E. Answers to unit test

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MODULE: INTRODUCTION TO AUTO MECHANICS

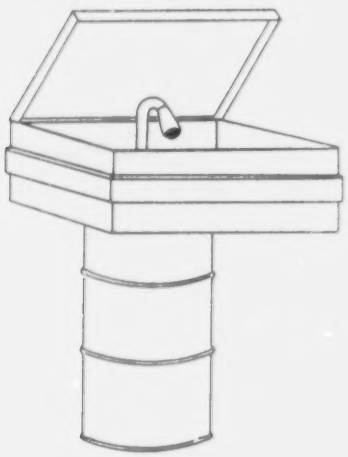
UNIT I: AUTOMOTIVE CHEMICALS AND THEIR USE

LESSON 1: USING SOLVENTS

I. Solvents used in the auto mechanics field

(NOTE: Solvents are aggressive liquids which dissolve oil, grease, dirt, or rust.)

A. Parts-washing solvent is a relatively inexpensive petroleum-based product, which dissolves oil, grease, and varnish from engine components and other parts of the automobile. Parts-washing solvent is usually dispensed in a powered washing tank, which filters and recycles the solvent. A brush is very helpful when cleaning parts in the solvent tank.



B. Choke and carb cleaner is a petroleum-based product that is often dispensed in an aerosol spray can. Choke and carb cleaner is more aggressive than parts-washing solvent in the cleaning of oil, grease, and varnish from carburetor components and other small precision-machined parts.

C. Brake cleaner is a solvent dispensed in an aerosol can. Brake cleaner is extremely effective in removing of grease and oil from brake drums, rotors, and engine flywheels.

D. Gasket remover is an aerosol product that loosens gasket material that may be tightly stuck to engine components with sealers or glue.

E. Digestive-type carburetor cleaner is a very aggressive chemical agent, which is usually stored in a one- or five-gallon container. A basket of parts is usually submerged into the container for cleaning. The chemical, which is a powerful base solution, will dissolve any organic material, leaving only clean metal parts, which are then rinsed with water.

II. Hazards and precautions related to the use of automotive solvents

A. Parts-washing solvent

1. While not as flammable as some other solvents, parts-washing solvent can burn and does present a fire hazard. The solvent tank should, therefore, be equipped with a safety link, which will melt should the solvent ignite. When the safety link melts, the lid on the washer tank will slam closed, smothering the fire. Keep electrical devices, sparks, and any hot material away from the parts-washing tank.

2. Parts-washing solvent presents a hazard to the eyes. The technician must wear eye goggles while using parts-washing solvent. The solvent can also be very irritating to the skin, especially when the solvent is fresh. Some individuals can have severe allergic reactions to the solvent. All technicians should wear rubber gloves when working with the solvent.

3. Parts-washing solvent can melt some shoe rubber and should never be splashed or poured on the shop floor. If a solvent spill is not immediately wiped up from the floor, it can easily cause people to slip and fall. Never put units such as electric motors in the solvent tank. Such units may sustain insulation damage; they may also be hard to dry on the inside. To extend the useable life of the solvent and to prevent clogging the tank, remove most of the grease, gasket material, and dirt from parts before washing and never pour other liquids into the solvent tank.

B. Choke and carb cleaner

1. Choke and carb cleaner is extremely flammable and thus presents a dangerous fire hazard. Never spray choke and carb cleaner on hot engine parts or around sparks or fire.

2. Choke and carb cleaner can damage paint. Do not spray choke and carb cleaner near the body of the car or other painted components.

3. Choke and carb cleaner can damage eyes and irritate skin. Always wear goggles and spray cleaner away from the body. Do not allow the cleaner to contact the skin.

4. Observe warnings on the choke and carb cleaner can. Do not burn empty choke and carb cleaner cans. Do not store choke and carb cleaner in a hot area. Do not expose the can to heat under any circumstances. Heat can cause the can to explode.

C. Brake cleaner

1. Brake cleaner is extremely flammable. Brake cleaner presents an especially severe fire hazard because the brake cleaner is sprayed from an aerosol can.

2. Brake cleaner can damage paint. Do not spray the cleaner near the body of the car or other painted components.

3. Brake cleaner can damage eyes and irritate skin. Always wear goggles and spray cleaner away from the body. Do not allow the cleaner to contact the skin.

4. Observe warnings on the brake cleaner can. Do not burn empty brake cleaner cans. Do not store brake cleaner in a hot area. Do not expose the can to heat under any circumstances. Heat can cause the can to explode.

D. Gasket remover

1. Gasket remover is extremely flammable. It presents an especially serious fire hazard because the gasket cleaner is sprayed from an aerosol can.

2. Gasket remover can damage paint. Do not spray the remover near the body of the car or other painted components.

3. Gasket remover can damage eyes and irritate skin. Always wear goggles and spray remover away from the body. Do not allow the remover to contact the skin.

4. Observe warnings on the gasket remover can. Do not burn empty gasket remover cans. Do not store gasket remover in a hot area. Do not expose the can to heat under any circumstances. Heat can cause the can to explode.

E. Digestive-type carburetor cleaner

1. Because digestive-type carburetor cleaner reacts vigorously with any organic material, it presents severe hazards to the technician's eyes and skin. Carefully read the warnings on the cleaner container. The technician must always wear goggles and rubber gloves when handling digestive-type carburetor cleaner.

   a. Any contact between digestive-type carburetor cleaner and human skin can be very harmful and should be considered an emergency situation. Therefore, the utmost care must be taken not to splash digestive-type carburetor cleaner.

   b. The entire digestive-type carburetor cleaner can should be carried to an appropriate area and the parts basket gently lowered and raised from the can. When the solvent has completed its job (20 minutes or longer), the solvent can should be carefully carried (with lid in place) to the sink. The basket of clean parts should be placed into the sink, and the parts rinsed in a gentle stream of water. Any spills must be cleaned up immediately. Any rags or towels used in the cleanup should be immediately discarded.

      (**CAUTION**: Digestive-type carburetor cleaner will quickly burn skin that it contacts, so flush afflicted areas immediately with water.)

2. Remember that digestive-type carburetor cleaner reacts with any organic substances and some nonorganic substances. Digestive-type carburetor cleaner should, therefore, be used only on metallic parts. Parts made of rubber, fiber, or plastic may be ruined by digestive-type carburetor cleaner. The cleaner may even remove anodized coatings along with paint and varnish. Always consult the instructor before using digestive-type carburetor cleaner on any parts.

3. To keep digestive-type carburetor cleaner from evaporating, a two-inch layer of water is often allowed to cover the cleaner as it sits in the can. All parts must, therefore, be completely submerged in the chemical during cleaning. To prevent spills, evaporation, and fumes, the lid must be closed tightly after the chemical is used.

4. Digestive-type carburetor cleaner is an expensive chemical and should be used only to clean small, precision components. Larger components should be cleaned with other solvents, such as parts-washing solvent.

F. The chemicals listed below are not suited to be used as solvents.

1. Gasoline should never be used as a cleaning solvent. Gasoline fumes are extremely flammable and, if ignited, can cause severe burns or death. Gasoline in liquid has also been shown to cause cancer in laboratory animals after prolonged exposure. Gasoline fumes may cause similar health problems. Gasoline additives can leave harmful deposits on important engine components.

2. Never use lacquer thinner or enamel reducer as solvent. The fumes from lacquer thinner or enamel reducer can severely dry and damage skin or eyes. Fumes from lacquer thinner or enamel reducer are as flammable as those from gasoline. If ignited, they can cause severe burns or death.

3. Acetone, ether, and other such chemicals present fire and health hazards similar to those of gasoline and reducer or thinner. Never use any of these chemicals for purposes other than those listed on the product can or container. Consult with the instructor before using any solvent or chemical.

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT I: AUTOMOTIVE CHEMICALS AND THEIR USE

LESSON 2: USING SOAPS AND CLEANING SOLUTIONS

I. Automotive soaps and cleaning solutions

(NOTE: Soaps and cleaning solutions are water soluble agents used for cleaning dirt and grease.)

A. Liquid detergent, also known as dish-washing liquid, is mild detergent that is convenient to use. Liquid detergent is suitable for washing engine blocks after honing or glaze breaking.

B. Glass cleaner and windshield washer solvents are available in aerosol, pump spray, or liquid. Best results are obtained when glass cleaner is used with paper towels rather than shop towels. (Shop towels almost always retain grease and leave lint.) Windshield washer solvent, either pre-mixed with water or in concentrate form, is used to refill the windshield washer reservoir.

(NOTE: When filling reservoir in winter time, read label on solution to see if it contains the necessary antifreeze. Freezing of the solution will result in a cracked reservoir tank due to expansion.)

C. Hand soaps that are typically used by automotive technicians contain an abrasive to help clean ground-in grease. If repeated washing with a certain type of soap is causing rawness or cracking of the skin, the technician may need to switch to a nonabrasive hand soap until his or her hands heal or become tougher over time. Hand lotion may ease the irritation of repeated hand washing, especially in the winter time.

(NOTE: Never use abrasive hand soaps on automobile finishes or plastics as scratches may occur.)

D. Hand-cleaning creams are often more effective than ordinary hand soaps on grease and dirt. Most cream manufacturers advise not to add water while rubbing on hands. Hand-cleaning creams are also available with abrasive for tough cleaning jobs. Use of these products is usually followed by normal washing with hand soap.

E. Hand-protecting creams, when applied before hands get dirty, are remarkably effective in preventing dirt and grease from staining hands and arms. Once the hands are cleaned (which requires only ordinary hand soap), the hand-protecting cream is also removed. Hand-protecting creams can, however, promote dryness of skin and will not stay on when using solvents.

F. Shop practices vary in regard to the type of detergent used to scrub floors. Some shops will use ordinary laundry detergent, while others may use a soap product specifically formulated for automotive shop floors. In either case, extra effort with mops or scrubbing brooms results in a cleaner floor.

1. When cleaning the floor, the floor must first be swept and all heavy spills must be cleaned up. The floor is then wetted and the detergent is added.

2. After scrubbing vigorously for several minutes, dirt, grease, and soap film should be flushed away with a large quantity of water. Squeegees are usually used last to push the water into the drain. Any residual wet areas must be dried or marked with a pylon to prevent slipping.

G. Some examples of specialty cleaning agents include the following: spot remover, bug and tar remover, velour upholstery cleaner, carpet cleaner, vinyl cleaner and conditioner, wire wheel cleaner, and white sidewall cleaner. Use these products as requested by the instructor and follow the product recommendations.

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT I: AUTOMOTIVE CHEMICALS AND THEIR USE

LESSON 3: USING OIL AND GREASE

I. Various oils, greases, and specialty additives

(NOTE: Oil and grease are either petroleum-based or synthetic products, which lubricate parts or act as a hydraulic fluid. If the lubricant is thick and does not run easily, it is referred to as a grease rather than an oil.)

A. Light oils or penetrating oils include rust-penetrating oil, silicone lubricant, and liquid graphite.

1. Light oils are often used to lubricate precision parts because the lubricant can get into tight clearances and will not attract as much dust and dirt as heavier oils.

2. Because they can dissolve some rust, rust penetrants are used to aid in the removal of rusty bolts and fasteners.

3. Liquid graphite dries to a slick, black coating that will not attract any dust or dirt, making it desirable for components with tiny moving parts such as locks.

B. Examples of standard and heavy oils are motor oil, automatic transmission fluid, power steering fluid, and gear lube.

1. Motor oils are either petroleum-based or synthetic products, which are used in all automobile engines. These oils are classified by viscosity (weight), e.g. 10w-30, and service classification, e.g. SF/SG. Always refer to the manufacturer's recommendations for the correct weight and service classification for the vehicle being serviced. Also refer to the manual for the proper interval for changing engine oil.

2. Automatic transmission fluid (ATF) is available in two basic types, Type F and Dexron II. Automatic transmission fluid is used in all automatic transmissions and some manual-shift, front-wheel-drive transaxles. Refer to manufacturer's recommendations for the selection and use of automatic transmission fluid.

3. Power steering fluid is similar to automatic transmission fluid; however, consult the instructor when filling a power steering reservoir to make sure the correct fluid is being used.

4. Gear lube is considerably thicker than motor oil or automatic transmission fluid and does a superior job of providing lubrication between the large and highly stressed gears of manual gear boxes and differentials. Refer to manufacturer's recommendations for the correct gear lube to use on the vehicle being serviced.

C. Hydraulic fluids include hydraulic jack oil and brake fluid.

1. Hydraulic jack oil is used in any shop equipment that has a hydraulic cylinder, such as jacks, engine hoists (cherry picker), lift rack, and forklift. Never attempt to add hydraulic jack oil to equipment without the supervision of the instructor.

2. Brake fluid is added to brake master cylinder reservoirs and clutch master cylinders of hydraulic clutch systems. Refer to the manufacturer's recommendations for the correct type of fluid for the vehicle being serviced. In America, brake fluids must be rated at least DOT-3 (Department of Transportation Specification #3) in order to be used. Use of an incorrect brake fluid can result in brake fade, the deterioration of rubber seals, and/or complete brake failure.

D. The various types of grease include multipurpose, wheel bearing, brake, cam lubricant (moly grease), white lithium, and stick type.

1. Grease is used when a lubricant must stay on parts for a long time and endure high pressure. Multipurpose grease may be suitable for lubricating such items as steering linkage components and wheel bearings. Multipurpose grease can also be used as an assembly glue when packing bearings into a manual-shift transmission. Read the information on the lubrication label before using multipurpose grease to be sure that it is recommended for the planned application.

2. Wheel bearing grease may be suitable for steering linkage components as well as bearings. If packing wheel bearings in a disc brake (high heat) application, be sure to use an extreme pressure (EP) bearing grease that is compatible with disc brakes.

3. Brake grease is applied in small amounts to the backing plate on vehicles equipped with drum brakes.

4. Cam lubricant is sometimes included with a new camshaft. The lubricant can help with breaking in the camshaft. Follow the directions included with the camshaft.

5. White lithium grease is a general purpose lubricant available in a tub or aerosol can. Some uses of white lithium grease include hood hinges, door stickers, hinges, cables, linkage, and shop equipment maintenance.

6. Stick lubricants are used on door strikers because they will not stain clothes.

E. Specialty additives include oil treatment, gas treatment, transmission conditioner, and starting ether.

1. Oil treatments are used to raise motor oil viscosity (thickness) or to free sticking valves or lifters. If an engine is very old and worn, or operated under severe loads, raising the oil viscosity may extend engine life by increasing oil pressure.

2. Starting ether is sometimes used to start an engine in extreme cold. The directions for using ether (starting fluid) must be followed carefully.

II. Hazards and precautions in the use, handling, and storage of oil, grease, and specialty additives.

A. Light or penetrating oil

1. Since light or penetrating oil is often sprayed from an aerosol can, it represents a significant fire hazard. Never spray these products near a flame, sparks, or heat. Spontaneous combustion (fire initiated without heat or sparks) can and does occur with rags soaked in any type of oil. Air flowing through the rags is the primary cause of spontaneous combustion. Oily rags must be stored in a metal safety container built for this purpose. The container must have a lid that closes tightly to prevent air moving through it.

2. The contents of aerosol cans are under pressure. The can must not be punctured or crushed--even when they are empty. Never store aerosol cans near heat or sparks. Never spray these products toward yourself. Always wear safety glasses.

3. Prolonged contact with oil, grease, and other chemicals should be avoided. Short-term contact with oil, grease, and other chemicals can cause irritation, chapping, or drying of the skin. Long-term contact may cause a variety of skin diseases, including cancer.

B. Standard and heavy oils

1. All types of oils, including standard and heavy oils, have a strong potential for spontaneous combustion when soaked into rags or paper towels. Rags must be stored in a metal safety container. Because oil will ignite at any temperature above zero when mixed with pure oxygen, oil must never be applied to oxyacetylene welding equipment.

2. Any time oil is dripped or spilled onto the shop floor, it must be cleaned up immediately to prevent someone from slipping. While small spills or drips may be wiped up with a towel, larger spills may need to be absorbed with sawdust or oil absorbent granules and then swept up and discarded. Any remaining slickness must be scrubbed with soap and water. The proper use of drain pans can prevent oil spills.

3. All oil must be stored in a designated area away from heat and sparks. Cans which seep oil must be used immediately or discarded.

C. Hydraulic fluids

1. The same fire hazard and spill considerations that apply to standard and heavy oils apply to hydraulic fluids.

2. Most hydraulic fluids, especially brake fluid, attack and dissolve paint. Many automobile finishes have received costly damage as a result of the careless use of brake fluid. Always cover fenders when adding brake fluid. Hands must be thoroughly washed immediately after contacting brake fluid.

   (NOTE: If you suspect that brake fluid has contacted a painted surface, immediately wash that surface with soap and water. To prevent unnecessary damage to the vehicle, a great deal of forethought must be exercised any time brakes are serviced.)

3. Hydraulic fluids, especially brake fluid, must be capped tightly to prevent dirt and moisture from contaminating the fluid. Even small amounts of moisture can turn to steam when brake fluid becomes hot during brake application. The steam will result in a spongy feeling pedal and reduce the effectiveness of the vehicle's brakes. Hydraulic fluids must be stored in a designated area away from sparks or heat. Never substitute other types of oil for hydraulic oil. Nonhydraulic oil may harm rubber seals or fail under the heat generated by the brake system.

4. Prolonged contact with oil, grease, and other chemicals should be avoided. Short-term contact may cause skin irritation, chapping or drying of the skin. Long-term contact may cause a variety of skin diseases, including cancer.

D. Grease

1. While usually not as flammable as oily rags, greasy rags present the same hazard of spontaneous combustion. Greasy rags must be stored in a metal safety container with a lid. Grease products should be stored in a designated area away from heat and sparks. Grease spills on floors must be wiped up and cleaned with soap and water immediately.

2. Some light-colored grease, such as white lithium grease, is not compatible with automatic transmission fluid and should not be used as an assembly glue or a prelube for internal transmission parts. If noncompatible grease is used during automatic transmission assembly, components in the valve body of the transmission can become stuck, resulting in shifting problems.

E. Specialty additives

1. Due to the wide range of specialty additives, specific hazards vary. Always refer to the container label for hazard warnings and handling procedures.

2. Adding too much oil treatment to a vehicle can result in poor lubricating properties or oil that exceeds proper viscosity, especially in cold weather. This can result in damage to engine components.

3. Gas treatment usually contains alcohol. Excessive amounts of methanol can destroy rubber carburetor or fuel system components and damage the lining of the fuel tank. Transmission conditioner can cause rubber seals to swell and fail.

4. Starting ether is extremely flammable and can create an explosion if the engine backfires.

III. Various automotive specialty chemicals

A. Sealers

(NOTE: Modern automobiles use two basic types of sealers: hardening and nonhardening.)

1. As hardening sealers dry, they form a hard seal between components.

2. Nonhardening sealers are used more often than hardening sealers. Nonhardening sealers resist both vibration caused by vehicle operation and expansion and contraction caused by temperature change.

3. Room temperature vulcanizing sealer (RTV) is the most frequently used nonhardening sealer. RTV is a special rubber which sets up at room temperature and forms a seal between components.

(NOTE: Some RTV sealants cannot be used on the engines of vehicles equipped with components such as oxygen sensors. Neither should some RTV sealants be used on automatic transmissions.)

4. Some sealers will harden at room temperature. These sealers are called anaerobic sealers.

B. Locking compounds prevent a fastener from loosening. A locking compound thus functions as a lock washer. Locking compounds have various strengths, ranging from "wrench removal" to "permanently bonded."

C. Antiseize compounds prevent threaded fasteners from becoming permanently bonded to another component. Antiseize compounds are commonly used when the fastener is made of a different type of metal from the component to which it is attached. (For example, an antiseize compound would be applied to a steel spark plug that is threaded into an aluminum cylinder head.)

IV. General rules for the use of automotive chemicals

A. Always adhere to manufacturer's recommendations.

B. Carefully read the product label for correct uses and hazards.

C. Use forethought to prevent spills, damage to a vehicle, or unsafe situations.

D. Store chemicals and used rags properly.

E. Use automotive chemicals for their intended purposes only.

F. Consult the instructor before using an unfamiliar product.

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT I: AUTOMOTIVE CHEMICALS AND THEIR USE

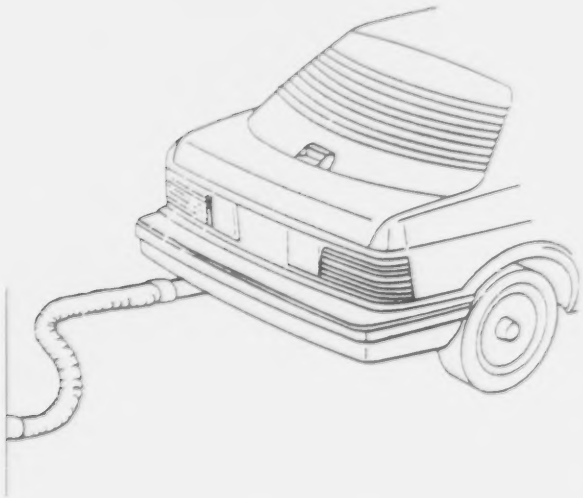
LESSON 4: GASSES AND DUST IN THE AUTOMOTIVE REPAIR FIELD

I. Gasses encountered in the auto mechanics field and the hazards they present

(**CAUTION**: The gasses usually encountered in the auto mechanics field include those emitted from engine exhaust, vapors resulting from evaporating fuel, and gasses stored in pressurized containers. Asbestos dust from brake linings and clutch discs is a hazardous material that requires special precautions.)

A. All internal-combustion gasoline engines emit a variety of gasses, which may contain carbon dioxide, water vapor, and, sulphur dioxide. These gasses present few, if any, health risks. There are, however, gasses present in the exhaust that are hazardous to health and must be considered carefully to prevent health risks. These gasses include oxides of nitrogen, hydrocarbons, and carbon monoxide.

1. Carbon monoxide results from incomplete combustion of fuel and air in the engine. When inhaled, it displaces oxygen in the blood, causing asphyxiation and death. Carbon monoxide has no noticeable odor, and therefore is particularly dangerous to the automotive technician. To avoid carbon monoxide poisoning, exhaust fumes must always be ventilated to the outside. Consult the instructor for the proper use of garage hoses in the shop. Any leaks in an automobile exhaust system must be repaired. Never sit for long periods in an idling car with the windows up.



2. Hydrocarbons contain hydrogen and carbon. Raw unburned gasoline is a hydrocarbon. Exhaust gas contains small amounts of hydrocarbons. Excessive levels of hydrocarbons in the body will cause nausea, vomiting, and possibly even cancer. To avoid the inhalation of hydrocarbons, exhaust fumes must always be ventilated to the outside.

3. Oxides of nitrogen are produced during high combustion temperatures. Oxides of nitrogen have a pungent odor and should be ventilated to the outside.

B. Fuel vapors, such as gasoline vapors, are extremely flammable and toxic. Gasoline vapors can be released from the fuel tank or other storage tanks and the engine carburetor. To avoid the risks of fire and explosion of fuel vapors, the following steps must be observed.

1. Gasoline destroys many types of containers, particularly those made of styrofoam, and must, therefore, be stored only in UL (Underwriters Laboratory) approved containers. These containers must then be stored in a metal safety cabinet so that any fumes are kept away from sparks and heat. Never leave gasoline open or uncapped in the shop area. Fumes can collect and explode.

2. Extreme care must be taken to avoid gasoline spills. Use a funnel when filling a gas tank. Wipe up spills immediately. Plug any disconnected fuel lines. Gas tanks must be drained or siphoned before being removed from the vehicle.

3. An apparently empty fuel tank is particularly dangerous since it is invariably full of fumes. Never attempt to weld a fuel tank yourself. This must be done only by experienced professionals in a shop equipped to thoroughly wash the tank first.

4. Sparks and heat must be kept away from engine carburetors. Even carburetors that have been emptied may contain gasoline residue and fumes. Never make electrical ground connections to the carburetor. If working on the carburetor, invert the carburetor and pour the gasoline into a suitable container.

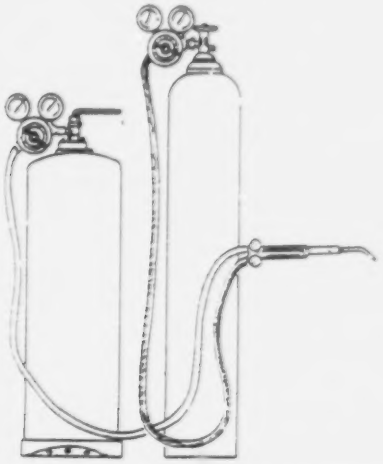
5. Consult the instructor for the proper disposal procedure in the shop. Never pour gasoline down a sink or into the sewer. Doing so is a serious violation of federal regulations.

C. Stored gasses

1. Propane is hydrocarbon gas, which is usually stored in metal containers under pressure. Mechanics use propane in torches, in some carburetor adjustments, and in vacuum leak detection. Propane tanks must be stored away from heat and sparks. The tank must never be punctured. Never discard a propane tank that still contains pressure.

2. Acetylene is a man-made hydrocarbon gas commonly used for the cutting and welding of metal. Acetylene gas is extremely flammable and chemically unstable. For these reasons, acetylene, in conjunction with oxygen, presents grave and unusual hazards. Only experienced technicians, after extensive safety training, should attempt to use an oxyacetylene torch set. Oil presents the most prominent danger to this apparatus, since it will create an explosion in the presence of pure oxygen.

(**CAUTION:** Never allow oil to contact any part of an oxyacetylene torch set or use oxygen or acetylene as compressed air.)



D. Freon is the refrigerant gas used in automotive air conditioning systems. Freon should not be directly inhaled or exposed to open flame. Freon is stored under pressure and creates extreme cold when released. If freon contacts the eyes, blindness can result. When freon gas is burned in a propane detector, a lethal gas called phosgene is released. For these reasons, freon gas must be used only by properly trained technicians. The area should be well ventilated and eye goggles must be worn. Never allow a freon can to be punctured or stored near heat.

II. The hazards and control of asbestos dust

A. Until recently nearly all brake and clutch linings contained asbestos, a material that can withstand extremely high temperatures. Asbestos dust has been shown to cause lung cancer, even in minute quantities. For this reason, special care must be exercised during brake and clutch work.

(NOTE: More complete procedures for dealing with asbestos will be covered in Module 6, Brakes.)

1. Never use compressed air to blow out brakes or clutches.

2. Wear a dust mask and use the proper dust evacuation system when working on brake systems.

3. All old brake linings and clutch discs must be returned to a tight-sealing box. Never leave these parts lying around the shop.

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT I: AUTOMOTIVE CHEMICALS AND THEIR USE

UNIT I TEST

SECTION A. **Read the statements below. Place a T or F in the blank beside each statement to indicate whether it is true or false.**

____ 1. Solvent for washing automotive parts is very expensive to purchase by the gallon.

____ 2. Choke and carburetor cleaner is a common term for digestive-type carburetor cleaner.

____ 3. Brake cleaner should be used to remove asbestos dust from brake components.

____ 4. When the safety link on the solvent tank melts, the tank lid will slam shut.

____ 5. Rubber gloves should be worn when working with parts-washing solvent.

____ 6. Electric motors should not be cleaned with parts-washing solvent.

____ 7. Carburetor cleaner is extremely flammable.

____ 8. Brake cleaner is not harmful to painted automobile finishes.

____ 9. Digestive-type carburetor cleaner should be used to clean large automobile components.

____ 10. Grease should be wiped up with a rag soaked in digestive-type carburetor cleaner.

____ 11. Gasoline can be used as a solvent in areas where sparks are not likely to occur.

____ 12. Lacquer thinner severely drys and damages the skin if used as a parts-washing solvent in the shop.

____ 13. Students should consult the instructor before using a chemical with which they are unfamiliar.

____ 14. After honing, engine blocks should be cleaned with liquid detergent.

____ 15. Windshield washer solvents may contain a form of antifreeze.

____ 16 Hands may have to be wetted before they are washed with hand-cleaning creams.

____ 17. Hand-protecting creams ease the irritation caused by hand soaps.

____ 18. Before the shop floor is scrubbed, it should be swept.

____ 19. Graphite lubricant does not attract dust.

____ 20. Gear lube is usually thinner than engine oil.

____ 21. Use of improper brake fluid can cause brake components to deteriorate.

____ 22. If an engine is very old and worn, or operated under severe loads, an oil treatment product may extend the engine's life.

____ 23. Aerosol oil cans should be punctured and crushed after use.

____ 24. Most hydraulic fluids can damage paint.

____ 25. White lithium grease is used to assemble automatic transmission components.

SECTION B. Select the best answer from the five choices listed.

____ 26. A gas that displaces oxygen and causes death is

a. carbon dioxide.
b. carbon monoxide.
c. hydro carbons.
d. oxides of nitrogen.
e. none of the above.

____ 27. A gas that has been proven to cause cancer in laboratory animals is

a. carbon dioxide.
b. carbon monoxide.
c. hydro carbons.
d. oxides of nitrogen.
e. none of the above.

____ 28. Gasoline should be stored in

a. styrofoam safety containers.
b. U.L. safety containers.
c. safety glass containers.
d. metal cans.
e. any of the above.

____ 29. Excess gasoline should be disposed of by pouring the gas

a. down the shop floor drain.
b. down the shop sink.
c. into a gutter.
d. on the ground around the shop.
e. into none of the above places.

____ 30. Oxyacetylene equipment should be oiled

a. once a year.
b. twice a year.
c. after each use.
d. after oxygen tanks are changed.
e. at no time.

____ 31. Freon is harmful if it is

a. burned.
b. inhaled.
c. taken internally.
d. splashed in the eyes.
e. all of the above.

____ 32. Asbestos dust is harmful to

a. elderly people.
b. people with respiratory ailments.
c. young children.
d. people with heart trouble.
e. all people regardless of age or health.

____ 33. Acetylene is commonly used in

a. cleaning parts.
b. removing paint.
c. welding.
d. sanding.
e. none of above.

____ 34. Oily rags should be stored in

a. cardboard boxes.
b. paper sacks.
c. plastic trash bags.
d. airtight metal containers.
e. none of the above containers.

____ 35. Engine oil is classified by service classification and

a. weight.
b. viscosity.
c. brand name.
d. motor service rating.
e. none of the above.

SECTION C. **Read each of the below statements made by Technicians I and II. Indicate which technician is correct by placing the appropriate letter in the blank beside each question.**

____ 36. Technician I says that the shop floor should be washed with parts-washing solvent.

Technician II says that gasoline should be used to wash the floor.

Who is right? (a) I only (b) II only
(c) both I and II (d) neither I nor II

____ 37. Technician I says that the two main types of automatic transmission fluid are Dexron II and Type F.

Technician II says that ATF stands for all purpose transmission fluid.

Who is right? (a) I only (b) II only
(c) both I and II (d) neither I nor II

___ 38. Technician I says that grease used on disc brake wheel bearings must be able to stand extreme pressure and extreme heat.

Technician II says that multipurpose grease is used on wheel bearings.

Who is right? (a) I only (b) II only
(c) both I and II (d) neither I nor II

___ 39. Technician I says that, for use in America, brake fluid must be rated at least DOT-3.

Technician II says that nonhydraulic oils may cause the seals in a transmission to swell.

Who is right? (a) I only (b) II only
(c) both I and II (d) neither I nor II

___ 40. Technician I says that exhaust gases must be vented outside the shop.

Technician II says that carbon monoxide and hydrocarbons have a detectable odor.

Who is right? (a) I only (b) II only
(c) both I and II (d) neither I nor II

(NOTE: The student's score on the Unit I Test will be his or her final evaluation for Competency A1. A score between ____ and ____ = 3; a score between ____ and ____ = 2; a sore between ____ and ____ = 1, and a score lower than ____ = N.)

ANSWERS TO UNIT I TEST

1. f
2. f
3. f
4. t
5. t
6. t
7. t
8. f
9. f
10. f
11. f
12. t
13. t
14. t
15. t
16. f
17. f
18. t
19. t
20. f
21. t
22. t
23. f
24. f
25. f
26. b
27. c
28. b
29. e
30. e
31. b
32. e
33. c
34. d
35. b
36. d
37. a
38. a
39. c
40. a

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT II: BASIC AUTOMOTIVE HAND TOOLS

UNIT OBJECTIVE

After completing this unit, the student should be able to identify basic hand tools and their proper use. The student will demonstrate mastery of the material by achieving a score of _____ on the unit test.

SPECIFIC OBJECTIVES

After completing the lessons in this unit, the student should be able to:

Lesson 1.
I. Identify the types and uses of common end wrenches (Competency A2, Unit II Test).
II. Identify the types and uses of various socket set components (Competency A2, Unit II Test).
III. Identify the types and uses of various wrenches (Competency A2, Unit II Test).

Lesson 2.
I. Identify the types and uses of various screwdrivers (Competency A2, Unit II Test).
II. Identify the types and uses of various styles of pliers (Competency A2, Unit II Test).

Lesson 3.
I. Identify the types and uses of various hammers (Competency A2, Unit II Test).
II. Identify the types and uses of various punches and chisels (Competency A2, Unit II Test).

ASE TASKS COVERED IN THIS UNIT

I. Only material that is preliminary to ASE tasks appears in this unit; therefore, no ASE tasks are covered directly.

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT II: BASIC AUTOMOTIVE HAND TOOLS

CONTENTS OF THIS UNIT

A. Objective sheet

B. References

C. Lesson plans

1. Lesson 1: TYPES OF WRENCHES AND SOCKETS

   a. Information outline

2. Lesson 2: TYPES OF SCREWDRIVERS AND PLIERS

   a. Information outline

3. Lesson 3: TYPES OF HAMMERS, PUNCHES, AND CHISELS

   a. Information outline

D. Unit test

E. Answers to unit test

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MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT II: BASIC AUTOMOTIVE HAND TOOLS

LESSON 1: TYPES OF WRENCHES AND SOCKETS

I. Various types of common end wrenches and their uses

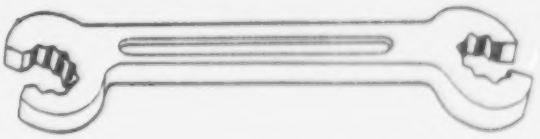
A. The open-end wrench is used to turn nuts and bolts that have already been loosened. This wrench grips the hex head of a nut or bolt on opposite sides and will round off the corners if too much torque (turning action) is applied. Normally the ends of the wrench are set at a 15-degree angle to reduce the distance the wrench must be moved in order to grip the next side of the hex head of a nut or a bolt. In order to take advantage of this feature, simply flip the wrench over after each partial movement.

B. The boxed-end wrench completely encircles the nut or bolt, gripping it at all corners. This secure grip allows considerably more torque to be applied without stripping the nut or bolt; therefore, this wrench is particularly useful for loosening tight bolts and nuts. Because the wrench completely encircles the hex head, more time is required to turn loose bolts with the boxed-end wrench.

C. The combination-end wrench is exactly what its name implies--a combination open-end and boxed-end wrench. This combination makes the wrench a favorite of the technician because the boxed-end wrench can easily break loose tight nuts and bolts while the open-end wrench can efficiently turn the bolts after they are loose.

D. A flare nut wrench (tubing wrench) is very similar to the boxed-end wrench in that the flare nut wrench encircles the hex head of a nut or bolt. However, a portion of one side of the flare nut wrench is cut away so that the wrench may be slipped over a steel line (such as a fuel line or brake line), and then inserted onto the fitting being loosened. By using the flare nut wrench for all steel line fittings, the technician can reduce the chance of rounding the fitting corners. Since the fitting is usually brass, only a flare nut wrench can loosen a tight fitting without damaging it. An open-end wrench may be used on the fitting after the fitting has been loosed with the flare nut wrench.

(NOTE: In addition to the flare nut wrench, an open-end wrench must be used to firmly hold the fitting into which a steel line is screwed. Never allow the steel line to become twisted.)



II. Various types of socket set components and their uses

A. The socket is the preferred tool of most technicians when they work with nuts and bolts because it can be turned by a ratchet handle or air impact gun.

B. Some types of sockets are listed below.

1. A shallow 12-point socket is used for turning bolt heads. The shallow 12-point socket can be easily positioned on the bolt head.

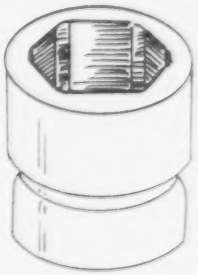
2. A shallow 6-point socket is also commonly used by technicians. Since the 12-point socket grips the bolt head at the extreme corners, it may round off the hex head when great torque is applied. For this reason, technicians prefer the 6-point socket when working with very tight bolts.

3. A deep-well 12-point socket is used to turn nuts when a bolt or stud protrudes through the nut enough to prohibit the use of the shallow socket.

4. A deep-well 6-point socket is used in the same situations as described above. The deep-well 6-point socket is particularly useful when there is a risk of rounding off tight nuts.

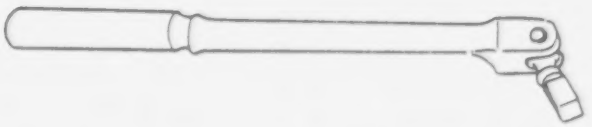
5. Swivel sockets (or universal sockets) have a universal joint built into the socket drive end. The universal joint allows bolts and nuts to be turned when it is not possible to get straight onto the head.

6. Impact sockets are designed to withstand the great torque and impact delivered by air impact tools. An impact socket has thicker construction than a standard socket. Using standard sockets on air impact guns is dangerous because the socket may shatter.



C. Bars and handles are used to turn the sockets. The drive end, which inserts into the rear of the socket, is square. The drive end is available in 1/4", 3/8", 1/2", and 3/4" sizes. The 3/4" size is used primarily for extremely large, heavy-duty bolts, which are often found in trucks. The 1/2" size is used on large automotive bolts. The 3/8" size is by far the most commonly used by technicians. For very small work, the 1/4" size is favored because of its compactness. Various types of bars and handles are listed below.

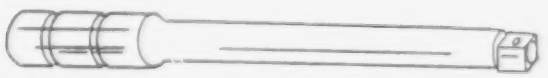
1. The breaker bar is a sturdy handle that is used when great torque is required to loosen bolts and nuts. The end of the breaker bar can swing to allow clearance as needed.



(NOTE: The length of the handle on the breaker bar provides superior leverage for tight nuts and bolts.)

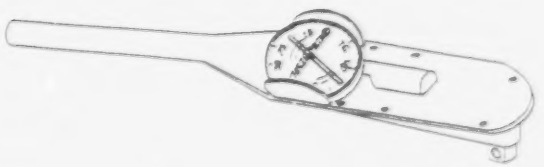
2. The ratchet is the most commonly used handle for turning sockets. By rotating back and forth, the ratchet can turn nuts and bolts in areas of limited access. Also, since the handle ratchets, it is not necessary to remove the tool from the bolt after each partial turn. This speeds the process of removal or tightening. The ratchet is not, however, intended to be used under extreme torque because the teeth on the ratchet mechanism may strip. Some ratchets have heads that swivel, allowing clearance while turning.

3. Extension bars aid in reaching recessed bolts and nuts by extending the ratchet drive end. Common extension lengths include 3", 6", and 12". Many other lengths are also available.



4. Speed handles and T-handles are occasionally used to speed assembly. One advantage of these handles is that they do not place side stress on the extension and socket. However, these handles are not usually used for the final tightening of a nut or bolt.

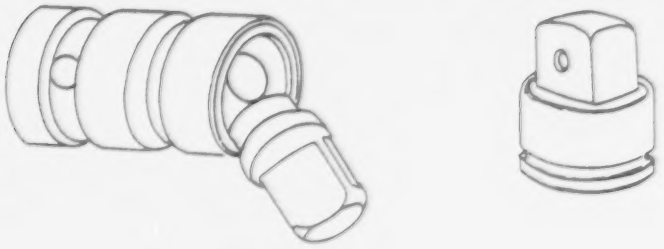
5. A torque wrench is a special handle that indicates when a certain torque or tightness has been reached. A wide variety of critical bolts must be tightened to a specific torque. Some torque wrenches have a scale or dial to indicate torque while others click or release momentarily when the preset torque is reached.



D. Occasionally the technician will use an adapter on a socket to make bolt removal easier. However, it should be noted that the torque capacity of the socket and ratchet must be considered so that the tool is not damaged or broken. Various types of socket adapters are listed below.

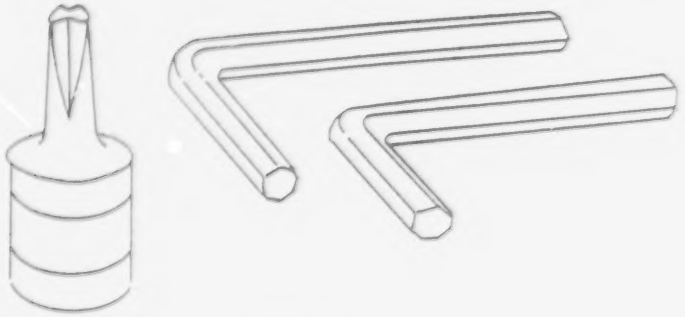
1. A size adapter allows the technician to use a different drive size socket on the ratchet or torque wrench. Extreme care must be exercised when adapting large breaker bars down to smaller drive sockets because the torque capacity of the small socket may be exceeded.

2. The universal adapter is a very useful device, which allows a socket to be used even where limited access prevents the ratchet and extension from engaging straight onto the socket. Experience will teach the technician that the universal adapter operates best at smaller angles and in certain positions. These adapters cannot withstand great amounts of torque.

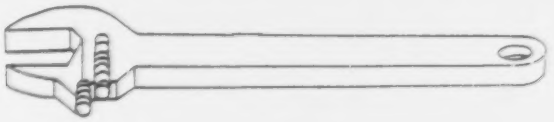


III. The various types of wrenches and their uses

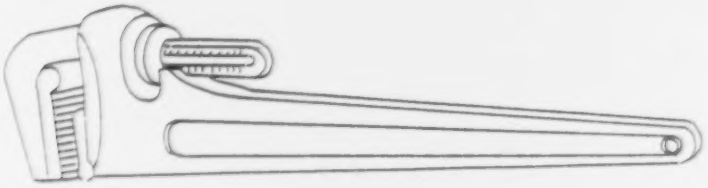
A. Instead of using the standard method of gripping the outside of the hex head, the technician can insert the allen and the torx wrench into the head of the fastener. An allen and torx bolt or a screw head contains a cavity with six sides (in the case of the allen), or six points (in the case of the torx). The allen or the torx wrench is inserted into this cavity. The allen and torx fasteners are becoming more popular in the auto motive industry. The allen and torx design reduces the risk of stripping or disengaging the threads of small fasteners.



B. Under normal circumstances, the technician will not use an adjustable wrench for turning nuts and bolts. Occasionally, an adjustable wrench will be used if the technician does not have immediate access to the proper wrench and if torque requirements are not too high.



C. Standard wrenches cannot be used on pipes because of the round shape of pipes. The pipe wrench has teeth, which dig in as the wrench is used to turn the pipe. The risk of scarring the pipe is reduced by placing a leather strap between the pipe and the wrench teeth.



MODULE: INTRODUCTION TO AUTO MECHANICS

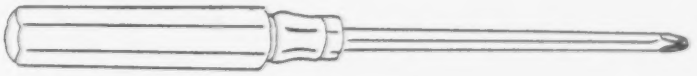
UNIT II: BASIC AUTOMOTIVE HAND TOOLS

LESSON 2: TYPES OF SCREWDRIVERS AND PLIERS

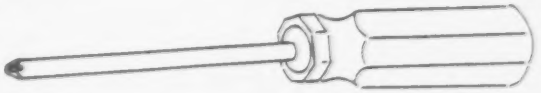
I. Various types of screwdrivers and their uses

A. The standard screwdriver has a straight blade for turning screws that have a slot which is the same width and length as the screwdriver blade. The standard screwdriver is not intended for use as a pry bar, chisel, or gasket scraper. These misuses of the screwdriver can damage the tool and injure the technician.

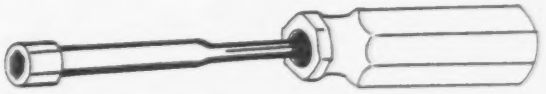
B. The phillips screwdriver fits the crossed slot of a phillips screw. Do not attempt to use a small standard screwdriver to turn a phillips screw. A good deal of pressure must be applied when using a phillips screwdriver or the tip may disengage the slot, damaging the screw and/or the tool. Once the slot of a Phillips screw is stripped, it is permanently ruined and will have to be drilled out.



C. The torx screwdriver has a 6-point tip that positively engages a screw head with the corresponding slot.



D. Nut drivers can be used in place of 1/4-inch drive sockets and ratchets. Because nut drivers can be operated with greater speed than sockets and ratchets, the nut drivers are ideal for the small hex head screws found on automobiles.



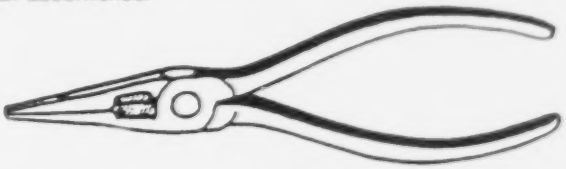
II. Types and uses of various styles of pliers

A. Standard slip-joint pliers are one of the most common type of pliers used by automotive technicians. Standard slip-joint pliers are used for gripping irregular parts and for holding work while drilling. Be sure to use the correct wrench for gripping nuts and bolts rather than using pliers that hold less securely and that may damage the hex head. The slip-joint allows larger parts to be gripped.

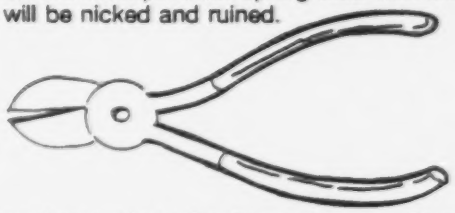
B. Locking pliers (often called vise-grips) are very similar to standard slip-joint pliers. Unlike standard slip-joint pliers, however, locking pliers will hold a piece of work securely once the pliers are clamped in place. This holding ability is desirable when an "extra hand" is needed. Locking are adjusted by turning a knob and then clamping the handles in place.

C. Adjustable joint pliers (also commonly known as channel-lock pliers) have a long slot with a wide variety of adjustment positions. The offset jaws of the adjustable joint pliers offer a reach advantage.

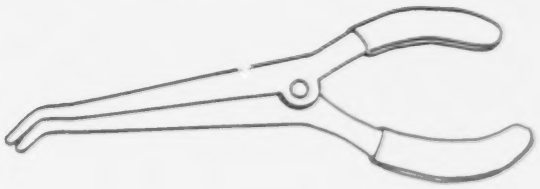
D. Long-nose pliers are useful for gripping tiny pins and parts during the service of carburetors and other small assemblies.



E. Electrician's pliers are useful for cutting electric wire and tape as well as a wide variety of other material. Electrician's pliers are also well suited for removing cotter pins on front-end components. Do not attempt to cut spring steel with electrician's pliers or the sharp edges of the pliers will be nicked and ruined.



F. Snap-ring pliers come in a variety of styles and types. Snap-ring pliers are required for spreading or compressing springy snap rings commonly found in transmissions and other automobile components. Some snap ring pliers spread the ring for the removal of outside-type snap rings. Other snap ring pliers compress inside-type snap rings.



MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT II: BASIC AUTOMOTIVE HAND TOOLS

LESSON 3: TYPES OF HAMMERS, PUNCHES, AND CHISELS

I. Various types of hammers and their uses

(NOTE: A wide variety of hammers are used by the automotive technician. Only the basic ones are covered below.)

A. The ball peen hammer is the most commonly used by the technician for driving punches and chisels.

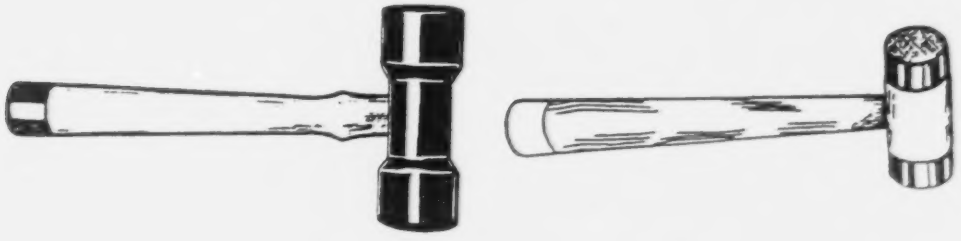
(**CAUTION:** To protect the eyes from flying metal chips, be sure to wear eye protection at all times while using a hammer, punch, or chisel. Never strike one hammer with another, because hammer heads are very brittle and metal chips may fly off of them.)

B. The technician will sometimes use a hand-held sledge hammer when a great deal of driving power is required.

(**CAUTION:** As with ball peen hammers, eye protection is always required.)

C. The technician may use brass- and bronze-tip hammers when it is necessary to avoid damage to the work being driven. Because brass and bronze are soft metals, they do minimal damage to iron and steel components.

D. When light driving power is needed (and when even a brass hammer may cause damage), the technician may use a plastic-tip hammer. Do not attempt to drive punches and chisels with this hammer, however. Doing so will destroy the hammer's plastic tip.



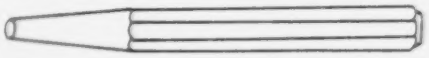
E. The rubber mallet is particularly useful for installing wheel covers. When installing wheel covers, always strike the cover evenly around the perimeter.

II. Various punches and chisels and their uses

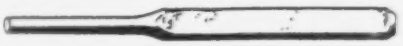
(**CAUTION:** Technicians use punches and chisels to drive and remove metal. Flying metal chips and sparks are hazards produced by these tools. Eye protection is absolutely necessary when working with these tools.)

A. Tapered or drift punches are the most commonly used punches in automotive work.

(**CAUTION:** As the punch is driven with a ball peen hammer, it will become "mushroomed." A mushroomed punch or chisel head is dangerous because a piece of metal will likely break off when the head is struck. Always grind [dress] the head of the punch back to a slight taper before using.)



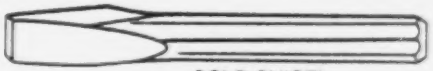
B. When a small roll pin must be driven through a hole, it is necessary to use a straight or pin punch (a tapered punch would bind in the hole). Watch for mushrooming of the punch head. The same safety considerations that apply to tapered punches also apply to straight or pin punches.



C. The center punch is used to make a small dimple in metal prior to drilling. This mark ensures that the hole will be drilled in the proper place, and that the drill bit will not "walk" out of position. Watch for mushrooming of the punch head. The same safety considerations that apply to tapered punches also apply to center punches.

D. Occasionally the technician must use a punch in an area in which flammable liquid or gas is present (when removing the gage unit from a gas tank, for example). The use of a standard steel punch would be dangerous, since sparks will be created by the steel-to-steel contact. The use of a brass or bronze punch assures that no sparks will be created. Watch for mushrooming of the punch head. The same safety considerations apply to brass or bronze punches as apply to tapered punches.

E. The standard cold chisel is commonly used to cut and remove metal. The end of the chisel should be ground to a sharp point on a 60-degree angle. As with a punch, the chisel must be dressed if it becomes mushroomed. Always wear eye protection when using chisels.



COLD CHISEL

F. A variety of chisel shapes are available to suit the particular job. These include the cape, the diamond point, and the round nose chisel. These chisels are used to cut or chip metal. Their heads may also become mushroomed. Always wear eye protection when using chisels.

ROUND NOSE CHISEL

DIAMOND POINT CHISEL

HALF ROUND CHISEL

G. To minimize the risk of missing the chisel and hitting his or her hand, the technician may use a chisel holder--especially when driving particularly stubborn parts.

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT II: BASIC AUTOMOTIVE HAND TOOLS

UNIT II TEST

SECTION A. **Match the tool with its name by placing the appropriate letter in the blank.**

___ 1. Breaker bar
___ 2. Open-end wrench
___ 3. Torque wrench
___ 4. Slip-joint pliers
___ 5. Locking pliers
___ 6. Adjustable pliers
___ 7. Ratchet
___ 8. Allen wrench
___ 9. Combination wrench
___ 10. Pipe wrench
___ 11. Cold chisel
___ 12. Snap ring pliers

a.

b.

c.

d.

e.

ab.

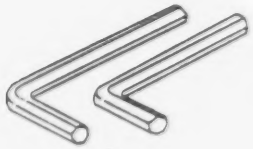
ac.

ad.

ae.

bc.

bd.

be. 

cd.

de.

ce.

SECTION B. Select the best answer from the five choices listed.

___ 13. A wrench commonly used to turn nuts and bolts that have already been loosened is the

a. open-end wrench.
b. boxed-end wrench.
c. combination wrench.
d. flare nut wrench.
e. torx wrench.

___ 14. A wrench that completely encircles the nut or bolt is the

a. open-end wrench.
b. box-end wrench.
c. combination wrench.
d. flare nut wrench.
e. allen wrench.

___ 15. A wrench that is used to remove fittings on brake and fuel lines is the

a. open end wrench.
b. boxed end wrench.
c. combination wrench.
d. flare nut wrench.
e. all of the above.

___ 16. When turning a nut or bolt with a great amount of torque, the technician should use a

a. 6-point socket.
b. 12-point socket.
c. 24-point socket.
d. 32-point socket.
e. 40-point socket.

___ 17. The type of socket used with an air wrench is called

a. a standard socket.
b. a deep-well socket.
c. an impact socket.
d. a pneumatic tool socket.
e. a soft socket.

___ 18. Socket bars and handles come in

a. 1/4" drive.
b. 3/8" drive.
c. 1/2" drive.
d. 3/4" drive.
e. all of the above sizes.

___ 19. Torque wrenches are used to

a. measure engine torque.
b. torque lines and hoses.
c. determine how tight bolts are prior to removal.
d. tighten nuts and bolts to the proper torque.
e. do none of the above.

SECTION C. **Read the statements below. Place a T or F in the blank beside each statement to indicate whether it is true or false.**

____ 20. The most common lengths for extensions are 3", 6", and 12".

____ 21. If too much pressure is put on a ratchet, the teeth on the ratchet mechanism may strip.

____ 22. A universal socket, like a universal wrench, can be used on nuts and bolts of many sizes.

____ 23. An open-end wrench can cause scarring if the work is not protected by a leather strap.

____ 24. A standard screwdriver is usually hardened so it can be used as a chisel.

____ 25. Slip-joint pliers are one of the most common type of pliers used by the automotive technician.

____ 26. locking pliers are used to tighten nuts and bolts.

____ 27. Side cutters can be used to cut spring steel.

____ 28. The sledge hammer is the most commonly used hammer in automotive work.

____ 29. Brass hammers will do no damage to iron or steel components.

____ 30. Chisels pose no danger to the technician.

____ 31. A pin punch is used to remove roll pins.

____ 32 A cold chisel is used to cut or remove metal.

(NOTE: The student's score on the Unit II Test will be a partial evaluation for Competency A2. A score between ____ and ____ = 3; a score between ____ and ____ = 2; a sore between ____ and ____ = 1, and a score lower than ____ = N. Final evaluation for Competency A2 will be made at the end of the Unit III Test.)

ANSWERS TO UNIT II TEST

1.	e
2.	ab
3.	ac
4.	ad
5.	ae
6.	c
7.	bc
8.	be
9.	d
10.	ce
11.	a
12.	cd
13.	a
14.	b
15.	d
16.	a
17.	c
18.	e
19.	d
20.	t
21.	t
22.	f
23.	f
24.	f
25.	t
26.	f
27.	f
28.	f
29.	t
30.	f
31.	t
32.	t

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT III: SPECIALTY TOOLS, FASTENERS, AND PRECISION MEASURING TOOLS

UNIT OBJECTIVE

After completing this unit, the student should be able to identify various types of specialty tools, fasteners, and precision measuring tools.

SPECIFIC OBJECTIVES

After completing the lessons in this unit, the student should be able to:

Lesson 1.
I. Identify the various types and uses of specialty tools (Competency A2, Unit III Test).

Lesson 2.
I. Identify the procedures for cutting threads onto a rod or into a hole, repairing damaged threads, and removing broken bolts (Competency A2, Unit III Test).

II. Identify the necessary information needed to describe common nuts and bolts in the English fractional system (Competency A2, Unit III Test).

III. Identify the necessary information needed to describe common nuts and bolts in the metric system (Competency A2, Unit III Test).

IV. Identify the various types of common automotive fasteners (Competency A2, Unit III Test).

Lesson 3.
I. Identify the different purposes of various measuring tools (Competency A2, Unit III Test).

II. Identify the procedures for the care and use of various measuring tools (Competency A2, Unit III Test).

ASE TASKS COVERED IN THIS UNIT

I. Only material that is preliminary to ASE tasks appears in this unit; therefore, no ASE tasks are covered directly.

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT III: SPECIALTY TOOLS, FASTENERS, AND PRECISION MEASURING TOOLS

CONTENTS OF THIS UNIT

A. Objective sheet

B. References

C. Notes to the instructor

D. Lesson plans

1. Lesson 1: AUTOMOTIVE SPECIALTY TOOLS

   a. Information outline

2. Lesson 2: AUTOMOTIVE FASTENERS

   a. Information outline

3. Lesson 3: AUTOMOTIVE MEASURING TOOLS

   a. Information outline

   b. Assignment sheet

      AS1-L3-UIII: Reading a Micrometer

E. Unit test

F. Answers to unit test

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NOTES TO THE INSTRUCTOR

A. Suggested approaches to teaching this unit

1. Students should do AS-L3-UIII before taking the Unit III Test.

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT III: SPECIALTY TOOLS, FASTENERS, AND PRECISION MEASURING TOOLS

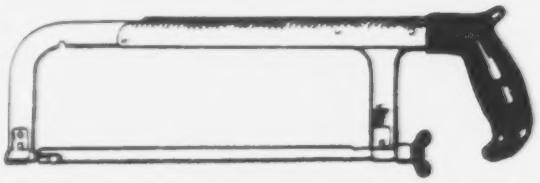
LESSON 1: AUTOMOTIVE SPECIALTY TOOLS

I. Various types of specialty tools and their uses

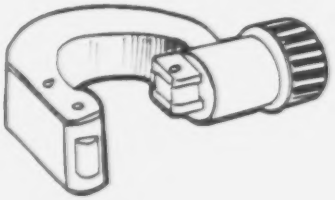
(NOTE: Specialty tools may not be used every day. However, they are necessary for some tasks that the auto mechanic will encounter. The tools presented below are only a small sample of the many specialty tools used by the technician. The instructor will probably have many more examples of specialty tools.)

A. Special cutting tools

1. Hack saws are used to cut metal parts to size or shape and are especially useful for removing damaged fasteners. Hack saws are sized according to blade length. Hack saw blades are designed to cut different materials. When installing the blade, make sure the teeth point away from the handle. The hack saw cuts on the forward stroke only. The saw is lifted on the return stroke.

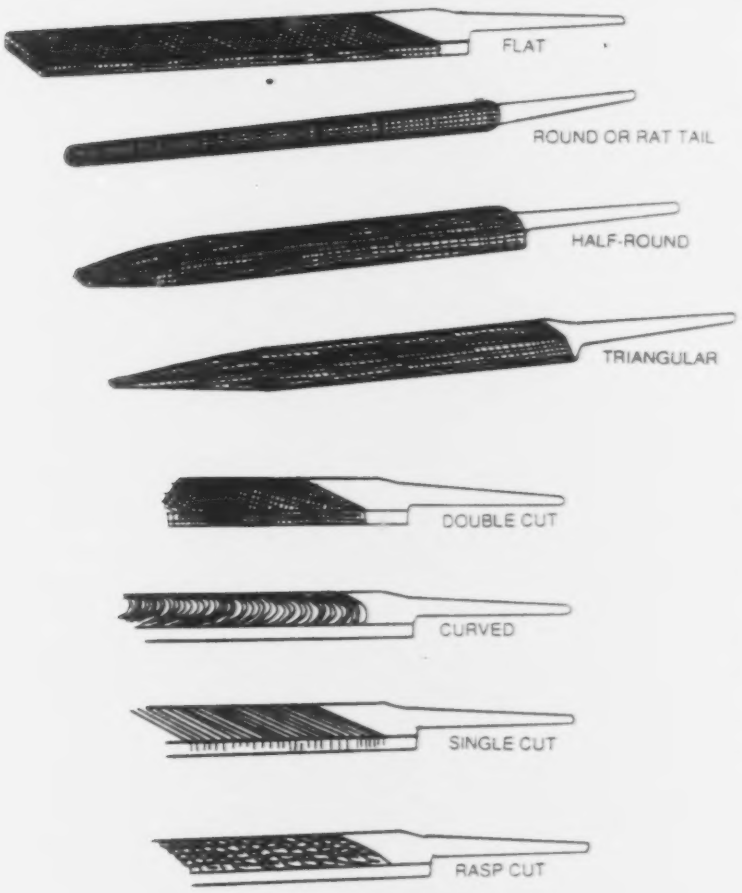


2. Tubing cutters cut tubing without bending, kinking, or scaring the tubing. Tubing cutters vary in size according to the diameter of the tube they are designed to cut. The cutter is placed on a piece of tubing and tightened as it is rotated.



3. A hand reamer is used to smooth or enlarge holes. Both straight and tapered reamers are used. Straight reamers may be either fixed in size or adjustable through a specific cutting range.

4. Files are used to smooth or shape metal. Files are designed in various shapes for different tasks. Files have different teeth designs for fine or rough work.



(**CAUTION:** Always use a handle on the file to prevent hand injury. Never hammer on or use a file as a pry bar. Files are brittle.)

B. Electrical system tools

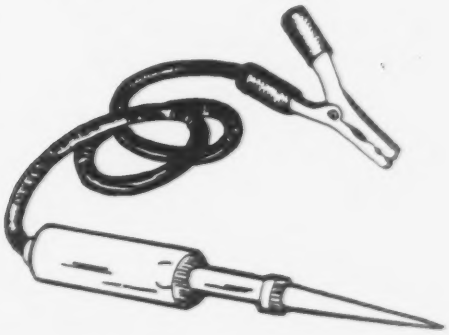
1. The volt/ohmmeter (VOM) is used to check electrical system components.

   (NOTE: A digital rather than an analog VOM is preferable.)

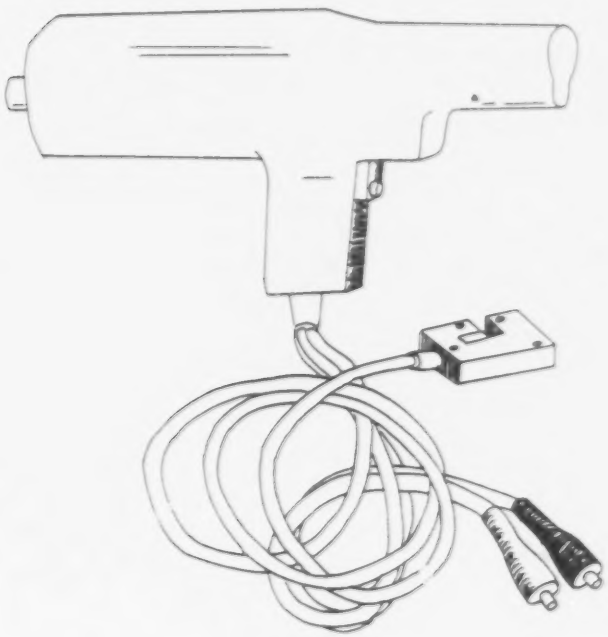
2. The dwell/tachometer is used to check engine speed and the duty cycle of various electronic components. Before electronic ignitions became popular, the dwell/tachometer was used extensively in checking the dwell setting on point-type ignition systems.

3. The continuity light is used to check for power in various circuits. One end of the light is grounded and the other end is pressed into the electrical device.

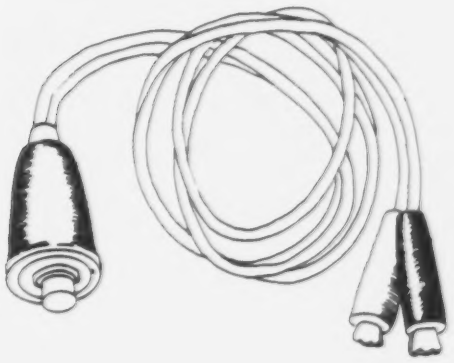
   (NOTE: The continuity light should never be used to check the power supply of electronic components.)



4. A timing light is used to determine if the ignition system is delivering the electric charge to the plug at the correct instant.



5. The remote starter switch allows the technician to use the vehicle's starter to crank the engine without the technician actually being in the vehicle.

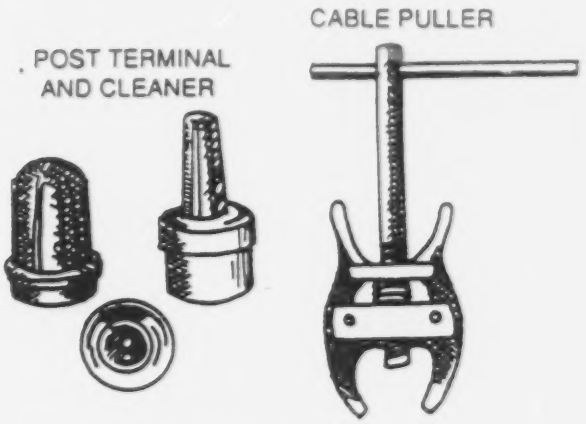


C. Battery specialty tools

1. A cable puller is used to remove the cable (from top-terminal batteries) without breaking the cable or battery posts.

2. Terminal and post cleaners are used on top terminal batteries to clean the posts and terminal ends.

3. A battery lifting or carrying strap is used to transport the battery safely.

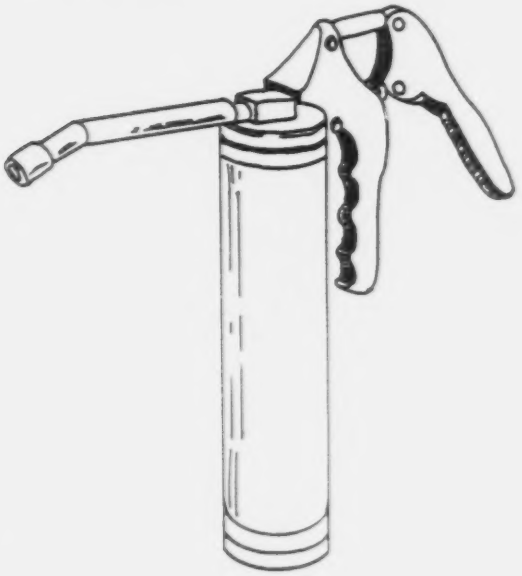


D. Lubrication specialty tools

1. A transmission funnel is simply a funnel with a long, small, flexible neck.

2. An oil filter removing tool may be either a wrench or a socket adapter used to remove an oil filter from a vehicle.

3. A grease gun forces grease into fittings. The gun uses pressure created by hand action on the gun's lever.

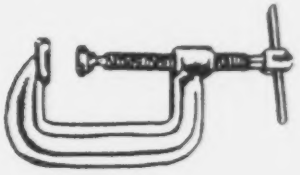


E. Miscellaneous specialty tools

1. Air nozzles are used to clean or dry various items in the shop.

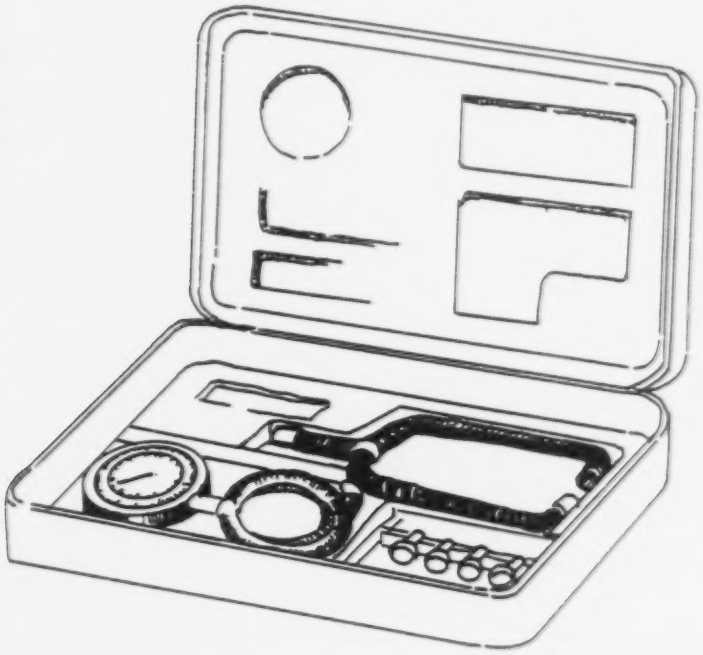
   (NOTE: Air nozzle pressure should not exceed 50 psi.)

2. The C-clamp is a holding device. C-clamps are most commonly used to compress the calipers on floating caliper disc brake systems.



3. A puller set is used to remove objects that are pressed onto their shafts. Examples of set pullers include harmonic balancer pullers and steering wheel pullers.

4. Pressure gauges are used to test the output of various hydraulic components such as the oil pump and the fuel pump. Vacuum gauges are used to check the condition of the engine and various vacuum-operated components.



MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT III: SPECIALTY TOOLS, FASTENERS, AND PRECISION MEASURING TOOLS

LESSON 2: AUTOMOTIVE FASTENERS

I. Procedures for cutting threads onto a rod or into a hole, repairing damaged threads, and removing broken bolts

A. A tap is used to cut threads into a hole.

B. Automotive construction uses two systems of thread measurement: the English and the metric systems.

1. The English system of thread measurement uses a fractional system to determine the diameter of the thread when it is 1/4" or larger. Each diameter will increase by 1/16" increments up to about 1/2"--for example, thread diameter sizes 1/4", 5/16", 3/8", 7/16", and 1/2". These are the most common sizes in the English system.

2. Smaller thread diameters use a wire size number. For example, #4, #6, #8, #10, and #12 are the most common sizes for small threads in the English system. Notice that the sizes are in increments of two.

3. The number of threads per inch determines whether the thread is referred to as coarse (National Coarse or USS) or fine (National Fine or SAE). All larger threads (1/4" and larger) will either be fine (NF or SAE) or coarse (NC or USS). The experienced mechanic can tell at a glance if a particular nut or bolt is fine or coarse.

(NOTE: Never attempt to screw a coarse bolt into a fine hole or vice versa. This will permanently damage the threads and often leads to breakage.)

4. Smaller thread diameters use certain thread-per-inch specifications. This number follows the wire size number. Examples are listed below.

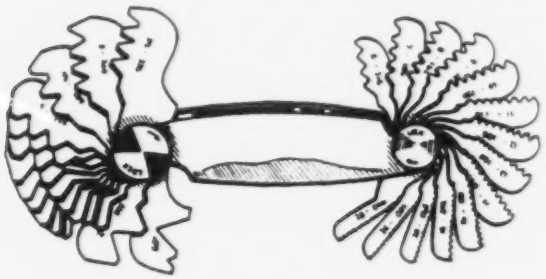
a. The 8-32 machine screw has a wire size of 8 and 32 threads per inch.

b. The 10-24 machine screw has a wire size of 10 and 24 threads per inch.

c. The 10-32 machine screw has a wire size of 10 and 32 threads per inch.

5. In the last few years, American automobile manufacturers have largely switched to the metric system of sizing fasteners and threads. The metric system is quite similar to the English system, except that the thread size is determined by measuring the distance in millimeters from the crest of one thread to the crest of the next one. The thread diameter is also expressed in millimeters (mm). For example, a 6mm-.25mm bolt has a diameter of 6mm and a thread of .25mm (crest to crest).

6. Most tap and die sets include a thread gauge, which greatly aids the technician in the determination of a particular small machine screw thread.



7. Before drilling a hole in which to cut threads with a tap, the technician must refer to a table that lists the correct drill bit size for each thread size. Failure to use the correct drill bit size can result in a broken tap or threads of inadequate depth.

8. Types of taps

   a. The tapered tap is the most commonly used tap because the taper allows easy starting. The tapered tap cannot cut threads to the bottom of a blind hole (a hole which does not go completely through the metal).

   b. The plug tap is used to cut threads part of the way to the bottom of a blind hole.

   c. A bottoming tap can cut threads all the way to the bottom of a blind hole but cannot start the cutting process. A tapered tap must be used before the bottoming tap can be used.

   d. The machine screw is a tap that cuts the small diameter threads of numbered screw sizes.

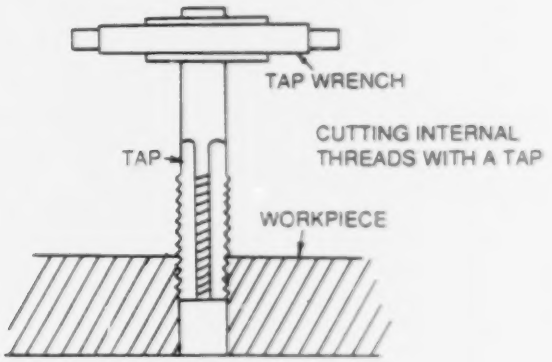
TAPER PLUG BOTTOMING MACHINE SCREW

9. Pipe threads are based on the inside diameter of 1/8" wall water pipes. Pipe threads taper so that the tightening process will create a seal. Common automotive pipe sizes are as follows: 1/8", 1/4", 3/8", and 1/2". Note that the size increments are by eighths of an inch.

C. A die is used to cut threads onto a rod. A special die stock holds the die for the cutting process.

D. Dies are selected in the same manner as taps; however, the die can be improperly placed in the die stock. Be sure that the die is positioned in the die stock so that the tapered end will engage the rod first.

E. Whether using a tap or die, the technician must first apply a thread cutting oil. Do not use a heavy motor oil for this purpose; motor oil will impede the cutting process. The handle with the tap or die is started straight; then a partial turn is made (about one half a turn). After each partial turn, back the tap or die off until the metal chips are felt to break loose. Repeat this process until all of the needed threads are cut.



F. Occasionally, the technician will encounter damaged or stripped threads. Listed below are various repair methods.

1. Chasing threads involves using a standard tap or die to run through existing threads of the same size. The purpose of this procedure is to correct small imperfections that impede the threading of the nut or bolt. Use a thread cutting oil during this procedure.

2. When threads in a hole are so severely damaged that they cannot be adequately repaired by chasing, a heli-coil can be installed to restore the threads back to their original sizes. This procedure involves completely drilling out the old, damaged threads with the appropriate drill bit (supplied in the heli-coil kit), tapping with a special tap (from the kit), and using a special handle to screw in an insert that looks like a spring or coil. The inside of this coil is the same as the original thread of the hole.

3. A thread insert can also be used to repair damaged threads. The thread insert is almost identical to the heli-coil; the insert, however, is somewhat larger (requiring a larger hole to be drilled and tapped), and is retained in place by driving down four pins around the insert.

4. Thread repair cement can be used on low-torque applications. The cement is applied to the bolt; the bolt is then placed back into the damaged hole. As this glue-like substance hardens, it conforms to the threads of the bolt, thus molding new threads.

G. If a bolt has broken off in a threaded hole as a result of overtightening, the bolt can be removed by using one of the methods listed below.

(NOTE: If the breakage occurred because the bolt either had the wrong thread design, was cross-threaded, or was bottomed out in the hole, the bolt may be in such a bind that its removal is impossible. If this is the case, the bolt will likely have to be drilled out and the hole retapped. To avoid this problem, always be sure to use the correct bolt and start it into the hole with the fingers.)

1. The screw extractor is one tool used to remove bolts. The screw extractor has flutes (grooves) that spiral in a counterclockwise direction. A hole must first be drilled in the center of the broken bolt; the easy-out is then threaded into the bolt with a tap handle in a counterclockwise manner. The taper of the tool will cause it to bind with the broken bolt, allowing it to be unthreaded.

2. If the bolt is not bound to the threaded hole at all, it is often possible to use a sharp punch that is dug into the bolt in such a way as to apply counterclockwise rotation when the punch is struck with a hammer. After a few turns, the bolt will usually be protruding enough to grip with pliers.

II. Identifying common nuts and bolts in the English fractional system

A. Bolt diameters come in increments of 1/16 inch, starting with 1/4 inch. This is a measurement of the overall diameter of the bolt threads. When making this measurement, it is easier to measure the unthreaded (shank) portion of the bolt if there is one. Nuts are very difficult to measure for diameter, so it is usually best to trial fit onto a bolt and then measure the bolt. Experienced technicians can recognize bolt diameters at a glance. The most common English system bolt diameters are 1/4", 5/16", 3/8", and 1/2".

B. The length of a bolt is its effective length measured from under the head to the end of the threads. Bolt lengths usually come in 1/4" increments, starting from 1/2 inch. Examples include 1/2", 3/4", 1", 1 1/4", 1 1/2", 1 3/4", 2", and 2 1/4"; these are common bolt lengths. The longest bolts normally encountered in auto mechanics are of 6 inches.

C. Another piece of information needed to describe a bolt is its thread type. This will be either fine (NF or SAE) or coarse (NC or USS). The experienced technician can determine fine and coarse threads at a glance. Never thread fine threaded bolts into coarse threads or vice versa.

D The strength of a bolt is an important consideration for the automotive technician. A bolt of insufficient strength may break. The strength (or hardness) of a bolt is determined by counting the points or slashes on the head of the bolt. Common bolt strengths are listed below.

1. No points (ungraded)--These bolts are nearly always unsuitable for automobile assembly due to their unknown and probably low strength. Do not use ungraded bolts.

2. Grade 5 (3 Point)--Grade 5 bolts are indicated by having three points on the head. These bolts are the most commonly used in automobile assembly.

3. Grade 8 (6 Point)--Grade 8 bolts are indicated by having six points on the head. These bolts are expensive but very strong and are used where high stresses may be encountered. Examples are harmonic balancer bolts, flywheel bolts, and steering linkage bolts. Never substitute a lower grade bolt for a grade 8.

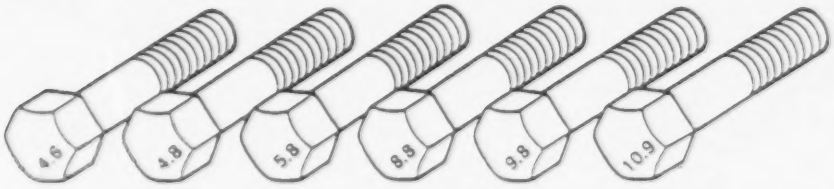
III. Information needed to describe common nuts and bolts in the metric system

A. The diameter of a metric bolt or nut is measured in the same way as in the English system. The diameter of a metric bolt, however, will be expressed in millimeters.

B. As in the English system, the bolt is measured for its effective length from under the head to the end of the threads.

C. Threads in the metric system are determined by a measurement from the crest of one thread to the crest of the next thread. This measurement is then expressed in millimeters.

D. Instead of points on the bolt head, metric bolt strength is indicated by a number marked on the bolt head. This number is called the property class. Examples of property class numbers include 4.6, 4.8, 5.8, 8.8, 9.8, and 10.9. Never substitute a bolt with one of less strength.



E. Notice that the description of a bolt or nut never indicates the size of wrench or socket that will be used to turn it. With experience, the technician will begin to know what size wrench to use on common English and metric bolts and nuts.

F. Occasionally, the technician will encounter nuts and bolts that turn the opposite way; these are called left-hand fasteners. One example is the left-side wheel lugs on very old automobiles (built before 1960) and Chrysler products up until the early 1970s. Left-hand nuts and bolts will either have notches cut at the corners of the hex head or will have the letter "L" stamped on them. Be sure to look for a notch or an "L" before attempting to loosen a nut or bolt.

IV. Other types of common automotive fasteners are listed below.

A. Bolt

B. Set screws

C. Self-tapping screws

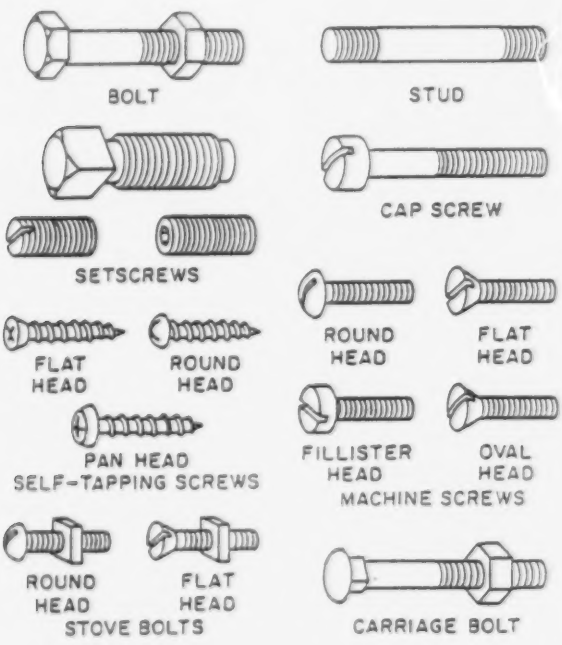
D. Stove bolts

E. Stud

F. Cap screw

G. Machine screw

H. Carriage bolt



MODULE: INTRODUCTION TO AUTO MECHANICS

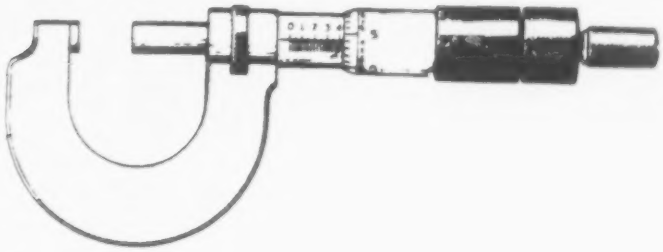
UNIT III: SPECIALTY TOOLS, FASTENERS, AND PRECISION MEASURING TOOLS

LESSON 3: AUTOMOTIVE MEASURING TOOLS

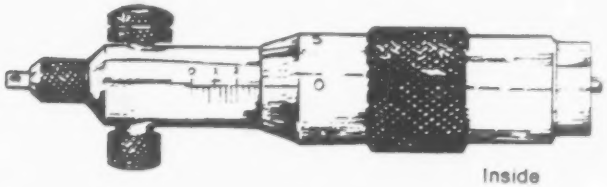
I. Different purposes of various measuring tools

(NOTE: Some automotive components, particularly in the engine and transmission, contain numerous precision machined parts that require precise measurements for inspection or replacement.)

A. The outside micrometer is a device that is used when an outside measurement must be accurate to one thousandth of an inch or less. Parts requiring such measurements include crankshafts, pistons, valves, and camshafts.



B. The inside micrometer is used when a measurement of the diameter of a hole must be accurate to less than one thousandth of an inch. Examples of such holes are cylinder bores and main bearing bores.

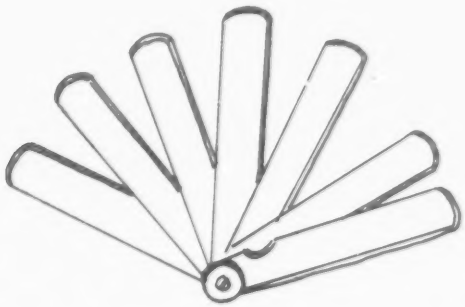


Inside

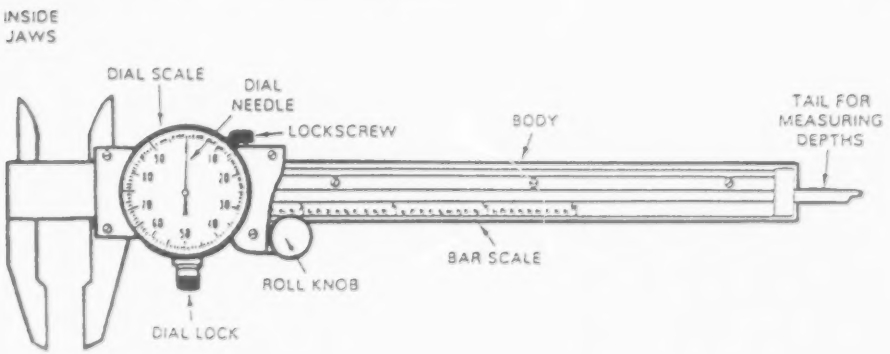
C. Plastigauge is a tiny rope of a clay-like material used to measure the clearance between engine bearings and their journals. Plastigauge is available in two sizes--one for measurements from 1/2 thousandth to 2 1/2 thousandths of an inch, and the other for 2 1/2 thousandths to 5 thousandths of an inch.

D. The dial indicator tool is used to measure thrust (back and forth) movement and runout (out of round). Such measurements are made on valves, crankshafts, and flywheels. The dial indicator can also be used to measure the backlash (movement) between gear teeth.

E. A feeler gauge is a tool that has numerous flat leaves of different specific thicknesses. A feeler gauge is used to measure air gaps and clearance between moving parts.



F. When less accuracy of measurement is required, a dial (vernier) caliper is sometimes used instead of the inside or outside micrometer. The technician may use the dial caliper to measure bolts and small machined parts.



G. The depth micrometer is an instrument used to make precise measurements of a hole or cavity. The technician may use the depth micrometer to measure the deck height of an engine block (i.e. the distance above the piston).

II. Procedures for the care and use of various measuring tools

(**CAUTION:** The care and use of precision measuring tools are critical to the accuracy and long life of the tool. An incorrect measurement can result in expensive component failure. Most measuring instruments are delicate and must be treated with the utmost care.)

A. The outside micrometer does not readily display the measurement. Some addition is required in order to arrive at the micrometer reading. The technician must develop a feel for the adjustment and use of the outside micrometer in order to achieve accurate and consistent results. This skill is developed over time.

1. Parts of the outside micrometer

a. Frame

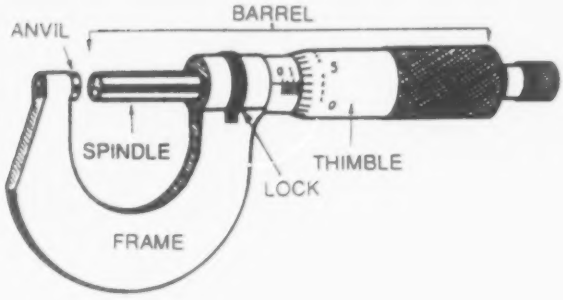
b. Barrel

c. Spindle

d. Anvil

e. Thimble

f. Lock



2. Procedure for reading the outside micrometer (Refer to figure below.)

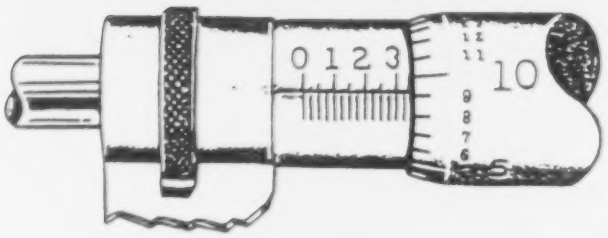
a. First, read the number indicated on the micrometer barrel. Notice that each number represents one tenth (.100) of an inch.

b. Add 25 thousandths (.025) of an inch for each additional iine showing on the barrel past the number.

c. Next, add the number of thousandths (.001) of an inch indicated on the thimble.

d. Finally, add the number of inches of the minimum dimension that the micrometer can read (zero, 1,2,3,4, or 5 inches).

e. Adding the above figures gives the indicated micrometer reading.



B. Care of the outside micrometer

1. Adjust the micrometer carefully. Only very slight pressure should be applied for tightening the thimble. When the thimble is correctly adjusted, there will be a slight and smooth pull when removing the micrometer from the part. Overtightening can destroy the adjustment of the micrometer. Never swing the frame of the micrometer around while holding the thimble. Do not adjust the thimble while the lock is on.

2. The micrometer should be kept clean and dry. It should be carefully stored in a closed box, away from dirt and moisture. Do not store 0- to 1-inch micrometers with the spindle against the anvil. Doing so encourages rust.

3. Check calibration frequently. Consult the manufacturer's manual for procedures.

C. The reading on inside micrometers is quite similar to that on the outside micrometer. Be sure to add the correct figure for the minimum measurement. Care and adjustment procedures are also similar to those for the outside micrometer.

D. Using plastigauge

1. Select a small piece of plastigauge material.

2. Place the plastigauge material on the crankshaft journal being measured. The plastigauge piece must span the full width of the journal and must be centered with the bearing cap.

3. Install the bearing cap and tighten it to correct torque specification.

4. Remove the bearing cap and inspect the plastigauge. The plastigauge should appear somewhat smashed. Compare the width to the paper gauge from which the plastigauge was taken.

E. Using the dial indicator

1. The dial indicator must be securely attached so that it will not move or rock and thus give inaccurate readings. The dial indicator is positioned either with a clamp-on base or a magnetic base.

2. Zero the dial by rotating the indicator until the needle is precisely on zero. If making a thrust measurement, the shaft or gear which is to be measured must first be pried one way.

3. Rotate the part for runout measurements or pry the gear or shaft for thrust measurements, and note the reading in thousandths of an inch on the dial.

4. The dial indicator is a very delicate instrument and cannot be dropped. Place all parts carefully back in the box and put the keeper bar back on the magnetic base (if so equipped) to retain the strength of the magnet. Store the indicator away from dirt and moisture.

F. Using the feeler gauge

1. Select a sample leaf and make a trial fit. If the leaf is excessively loose or excessively tight, select another leaf and try again.

2. When the correct leaf is found, there will be a slight, smooth drag as the feeler gauge is removed. The thickness of the leaf is printed on the leaf.

3. Keep a little oil on the leaves to prevent rust. Store away from dirt and moisture.

G. The dial caliper is relatively easy to use. The caliper is adjusted until the jaws lightly contact the work, and a reading is made off the dial, adding it to the linear scale. The care of this precision device is the same as for the other precision measuring instruments.

H. Depth micrometers are read in much the same way as the inside micrometer.

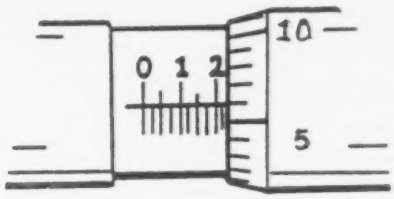
(NOTE: Be sure to add the correct minimum measurement, depending upon the spindle selected. The care of this precision device is the same as for the other precision measuring instruments.)

MODULE: INTRODUCTION TO AUTO MECHANICS

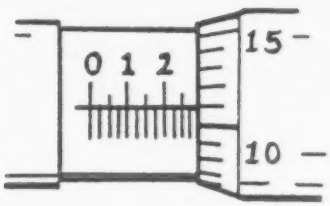
READING A MICROMETER

Instructions: Do the following tasks. Write all responses on this sheet.

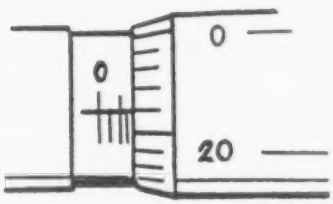
1. Give the correct micrometer reading for each example below.



Reading _____



Reading _____



Reading _____

MODULE: INTRODUCTION TO AUTO MECHANICS

READING A MICROMETER

(ANSWER SHEET)

1. .231, .286, .096

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT III: SPECIALTY TOOLS, FASTENERS, AND PRECISION MEASURING TOOLS

UNIT III TEST

SECTION A. Match the specialty tool on the right to a description of its use on the left.

____	1.	This device should not be used to test electronic components.	a.	hack saw
____	2.	This device is used to enlarge or smooth drilled holes.	b.	hand reamer
			c.	file
____	3.	This device is used to shape or smooth metal.	d.	VOM
____	4.	A digital model of this tool is preferable.	e.	dwell/tach
			ab.	continuity light
____	5.	This tool is used to crank the engine from outside the passenger compartment.	ac.	timing light
			ad.	remote starter switch
____	6.	This tool is used to dry parts.	ae.	air nozzle
____	7.	This tool is used to remove battery cables.	bc.	terminal puller
____	8.	This device reads engine speed in rpm.		
____	9.	This device is used to cut metal parts.		

SECTION B. **Match the precision measuring tool on the right to its use on the left.**

____	10.	This device is used instead of a micrometer when less accuracy is needed.	a. outside micrometer
____	11.	This device is used to make precise measurements in a cavity.	b. inside micrometer
____	12.	This device is used to measure clearance between bearings.	c. plastigauge
____	13.	This device is used to measure thrust and runout.	d. dial indicator
____	14.	This device is used to make very accurate measurements of the inside of bore.	e. feeler gauge
____	15.	This device is used to measure air gaps and clearance between moving parts.	ab. dial (vernier) caliper
____	16.	This device is used to make a very accurate measurement of pistons and crankshafts.	ac. depth micrometer
			ad. inside caliper
			ae. hole gauge

SECTION C. Read the statements below. Place a T or F in the blank beside each statement to indicate whether it is true or false.

____ 17. Hack saw blade teeth should face forward away from the handle.

____ 18. Files should never be used without the proper handle.

____ 19. A C-clamp is commonly used for disc brake repair.

____ 20. Pressure gauge sets can be used to check spring pressure.

____ 21. A vacuum gauge can be used to check engine condition.

____ 22. A tap is used to cut threads on a bolt.

____ 23. The number of threads per inch determines the strength of a bolt.

____ 24. The term "tap drill" refers to a combination tap/drill bit.

____ 25. Pipe and common threads are the same.

____ 26. Engine oil should be used as lubrication when cutting threads.

____ 27. The term chasing threads refers to cleaning threads with a tap.

____ 28. Thread repair cement cannot be used in high torque applications.

____ 29. Before a screw extractor is used, the broken bolt must be drilled.

____ 30. Most bolts must be turned clockwise (to the right) to be loosened.

____ 31. Bolt length is determined by measuring from the end of the threads to the top of the head.

____ 32. Threaded fasteners are graded according to their strength.

____ 33. Adhesives are often used to hold moving parts together.

____ 34. The technician must know calculus in order to read a micrometer.

____ 35. Precision tools should be handled carefully.

____ 36. Feeler gauges are used to measure the clearance between the crankshaft and its bearings.

____ 37. Micrometers should be stored clean and dry if they are to work correctly.

____ 38. An outside micrometer is a sturdy instrument that can withstand much abuse.

SECTION D. Select the best answer from the five choices listed.

___ 39. If a machine screw is sized 8-32, the number 8 represents

a. threads per inch.
b. diameter of the threads.
c. strength of the screw.
d. material used in the screw.
e. none of the above.

___ 40. SAE threads are considered

a. fine threads.
b. course threads.
c metric threads.
d. medium threads.
e. none of the above.

___ 41. The type of tap that cannot be used to start the cutting process is

a. a taper tap.
b. a plug tap.
c. a machine tap.
d. a bottoming tap.
e. none of the above.

___ 42. Pipe threads

a. are the same as bolt threads.
b. taper to aid sealing.
c. are cut with large taps.
d. are usually fine threads.
e. increase in size by increments of 1/4".

___ 43. When cutting threads,

a. use cutting oil.
b. make sure the threads are cut straight.
c. make sure the tap is of the correct size for the hole.
d. turn the tap or die only 1/2 turn at a time, then back off.
e. do all the above.

___ 44. Heli-coil thread repair

a. is a form of thread insertion.
b. calls for the use of a larger bolt.
c. cannot be used in high-torque applications.
d. is used to clean threads in tapped holes.
e. does none of the above.

___ 45. To prevent cross threading a bolt,

a. use the correct tap.
b. use the correct die.
c. start bolts with a power tool.
d. start bolts with fingers.
e. use cutting oil when threading a bolt.

___ 46. On the head of metric and SAE bolts, the technician will find

a. the grade or hardness of the bolt.
b. the length of the bolt.
c. the diameter of the bolt.
d. the wrench size for the bolt.
e. none of the above.

___ 47. The numbers on the barrel of a micrometer represent

a. inches.
b. .100 inch.
c. .010 inch.
d. .001 inch.
e. none of the above.

___ 48. A two-inch outside micrometer can measure distances

a. between 1" and 2".
b. between 2" and 3".
c. all distances under 2".
d. all distances greater than 2".
e. of none of the above.

(NOTE: The student's score on the Unit III Test will be his or her partial evaluation for Competency A2. A score between ____ and ____ = 3; a score between ____ and ____ = 2; a sore between ____ and ____ = 1, and a score lower than ____ = N. Follow the instructions below to determine the student's final evaluation for Competency A2.)

FINAL EVALUATION INSTRUCTIONS

I. Determine the student's final evaluation for Competency A2 by averaging the evaluations from the Unit II Test and the Unit III Test. Use the spaces provided below.

	Evaluation 3 2 1 N
Evaluation from the Unit II Test	— — — —
Evaluation from the Unit III Test	— — — —
Final evaluation for Competency A2	— — — —

ANSWERS TO UNIT III TEST

1. ab
2. b
3. c
4. d
5. ad
6. ae
7. bc
8. e
9. a
10. ab
11. ac
12. c
13. d
14. b
15. e
16. a
17. t
18. t
19. t
20. f
21. t
22. f
23. f
24. f
25. f
26. f
27. t
28. t
29. t
30. f
31. f
32. t
33. f
34. f
35. t
36. f
37. t
38. f
39. e
40. a
41. d
42. b
43. e
44. a
45. d
46. a
47. b
48. b

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT IV: POWER TOOLS AND SHOP EQUIPMENT

UNIT OBJECTIVE

After completing this unit, the student should be able to identify power tools and basic shop equipment and safety measures that apply to their use. The student will demonstrate mastery of the material by achieving a score of _____ on the unit test.

SPECIFIC OBJECTIVES

After completing the lessons in this unit, the student should be able to:

Lesson 1.

I. Identify the types and uses of pneumatic, hydraulic, and electric power tools (Competency A3, Part I of the Unit IV Test).

II. Identify the hazards of power tools (Competency A3, Part I of the Unit IV Test).

Lesson 2.

I. Identify the types, purposes, and safety considerations of common shop equipment (Competency A6, Part II of the Unit IV Test).

ASE TASKS COVERED IN THIS UNIT

I. Only material that is preliminary to ASE tasks appears in this unit. No ASE tasks are covered directly.

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT IV: POWER TOOLS AND SHOP EQUIPMENT

CONTENTS OF THIS UNIT

A. Objective sheet

B. References

C. Lesson plans

1. Lesson 1: POWER TOOLS

a. Information outline

2. Lesson 2: SHOP EQUIPMENT

a. Information outline

D. Unit test

E. Answers to unit test

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MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT IV: POWER TOOLS AND SHOP EQUIPMENT

LESSON 1: POWER TOOLS

I. Various types and uses of pneumatic, hydraulic, and electric power tools

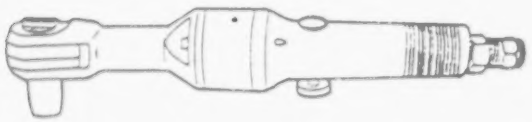
(NOTE: Technicians use power tools to speed and improve the quality of repairs.)

A. Pneumatic tools use compressed air for power. Compressed air is always available in the professional shop. Air is put under pressure by a compressor. The air is delivered through pipes at a pressure of 150 psi or more. Flexible rubber hoses join the air powered tool to the pipes through quick-connecting couplings. Due to the high pressure and the great power of many of these tools, great care must be exercised to ensure their safe operation. Examples of pneumatic tools are listed below.

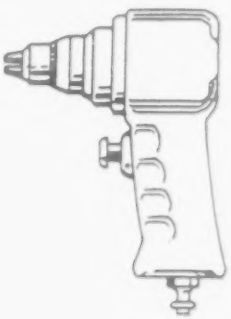
1. Air impact guns are available in 3/8" and 1/2" drive sizes for typical automotive work. Larger sizes are available for big truck repairs. Torque of 250 foot pounds or more may be created by the air impact gun.

2. Air hammers are also commonly used by the automotive technician. The air hammer creates a rapid hammering action, which is useful for rapid chiseling and driving. Other attachments are available for cutting sheet metal and tail pipe.

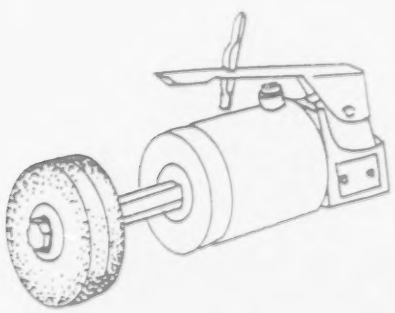
3. The air ratchet is used for loosening or tightening small bolts. The air ratchet produces considerably less torque than the air impact gun. An air ratchet should be used only to snug a bolt. A conventional ratchet or torque wrench should be used to complete the tightening of a bolt. The technician should develop a good feel for the use of a standard ratchet before advancing to the use of an air ratchet.



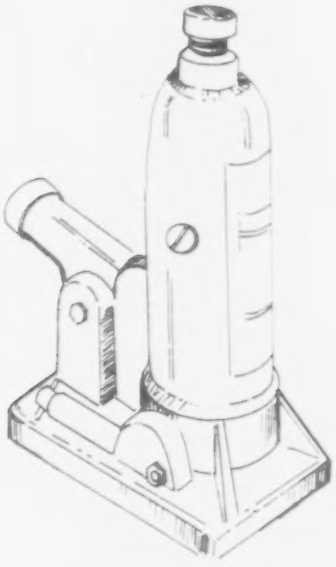
4. The air drill is used, of course, for drilling, but small abrasive attachments can be added to the drill for removing dirt, rust, and gasket material from components.



5. The tire burnishing tool is often used at tire repair shops. The tire burnishing tool roughs up the rubber on the inside of the tire. This roughing-up prepares the rubber for the application of a tire patch.



B. Hydraulic tools use pressurized fluid within a cylinder to create great pressure. The hydraulic pressure within the tool is usually created by the manual pumping of a handle or by air pressure. Since these pieces of equipment are usually quite large and are not a part of the mechanic's personal hand tool set, they will be covered in the lesson on shop equipment in this unit.

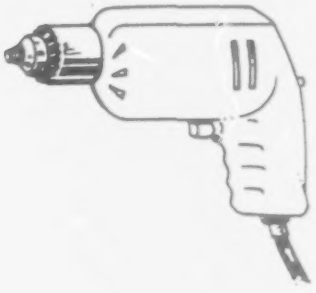


C. Electrical hand tools plug into the standard 110-120V outlets in the shop.

1. A drop light can be used to illuminate areas under the hood, dash, or car. Proper illumination is critical to safe, high-quality repairs.

2. The electric drill can be used either with drill bits or with special attachments, which can remove rust or gasket material.

(NOTE: Other electrical tools will be covered in the unit on shop equipment in this module.)



II. Identifying the hazards of power tools

A. The compressed air used in pneumatic tools creates unique hazards for the automotive technician. These hazards are listed below.

1. Air impact guns, air hammers, and air drills can create flying metal chips that are dangerous to the eyes. Wear proper eye protection at all times when working with or around air tools.

   (**CAUTION:** When flying metal chips are a possibility, the technician should always wear eye protection, face protection, protective clothing, and gloves.)

2. Pneumatic tools can produce a great deal of power. Using an improper attachment or placing the attachment on the tool incorrectly can result in breakage. Use only impact sockets on air impact guns. Use the correct attachments with air hammers and be sure the safety retainer is in place.

3. Water and oil accumulate in air compressors and should be drained daily. Even with daily draining of the compressor, however, compressed air will still carry infection. Should the high pressure air stream be directed against the skin or into an existing wound, death or sever infections requiring the amputation of a limb may result. Never play with compressed air blow guns or hoses. Look over hands for cuts before using compressed air. Air pressure in blow guns should be about 50 psi.

4. The use of pneumatic tools usually creates a great deal of noise. Be sure to wear ear plugs or other types of ear protection when using pneumatic tools.

B. The hazards of hydraulic tools will be discussed in Lesson 2 of this unit.

C. Electrical hand tools

1. Electrical hand tools plug into shop electrical outlets and, therefore, carry enough electrical power to cause severe shock or electrocution. Inspect the tool's power cord and any extension cords prior to plugging in the tool. All electrical tools must have a three-prong plug (i.e. have a ground terminal) unless the tool is double insulated. Double-insulated tools, due to their construction, cannot short to the outside case and, therefore, require only a two-prong plug. Any frayed or bare wires must be repaired before the tool is used. Consult the instructor if the tool has frayed or bare wires. Never eliminate the ground terminal of three-prong plug by using an adaptor or by clipping. Never allow cords to lie in water or across moving machinery. Wrap up cords carefully after use and store them properly.

2. Some electrical tools, particularly drop lights, can become very hot while being used. Never touch a drop light while it is on. Make sure that the drop light is not in a position to melt plastic or rubber materials in the car. Never use a drop light to keep a battery warm.

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT IV: POWER TOOLS AND SHOP EQUIPMENT

LESSON 2: SHOP EQUIPMENT

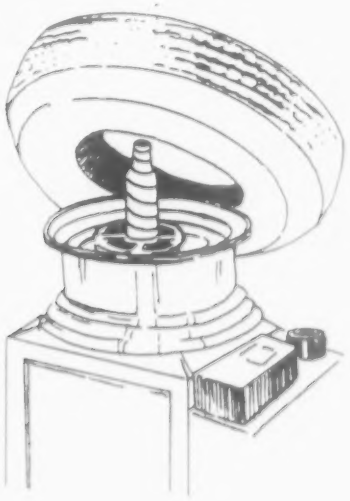
I. Types, purposes, and safety considerations relating to common shop equipment

(NOTE: The term "shop equipment" refers to large and/or expensive pieces of equipment or tools, which are usually provided by the shop owner.)

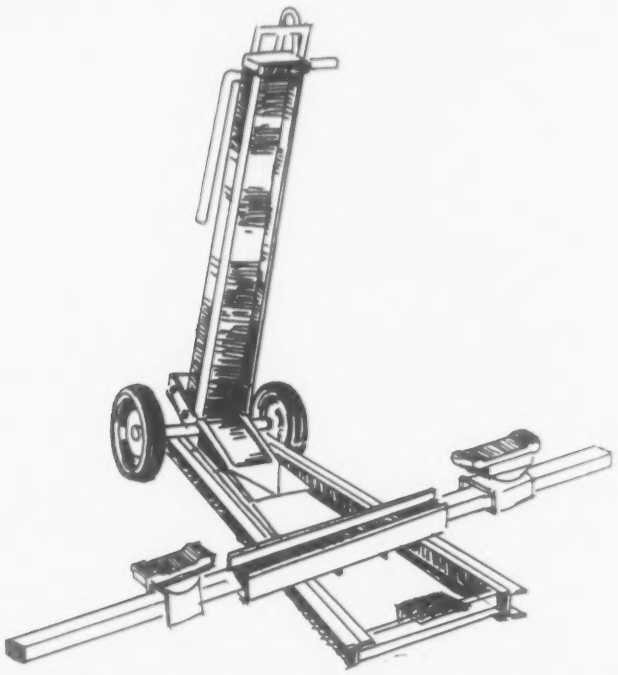
A. Pneumatic equipment can either be permanently attached to the shop air compressor or temporarily attached to the compressor by rubber hoses. The tire machine and the pneumatic jack are examples of pneumatic equipment.

1. The tire machine is used to remove and reinstall the tire onto the wheel. The tire machine also inflates the tire to the proper pressure. The machine uses great force to manipulate tires (there is also a great deal of force contained in an inflated tire) The tire machine is, therefore, one of the most dangerous pieces of equipment in the shop. Students should not use the tire machine without thorough training.

(NOTE: Truck tires which use the "split rim" type of mounting are particularly dangerous when removed or installed on a tire machine. These truck tires must be inflated in a special cage. Consult the instructor before attempting to mount a truck tire or any type of tire. Always wear eye protection when working with a tire machine.)

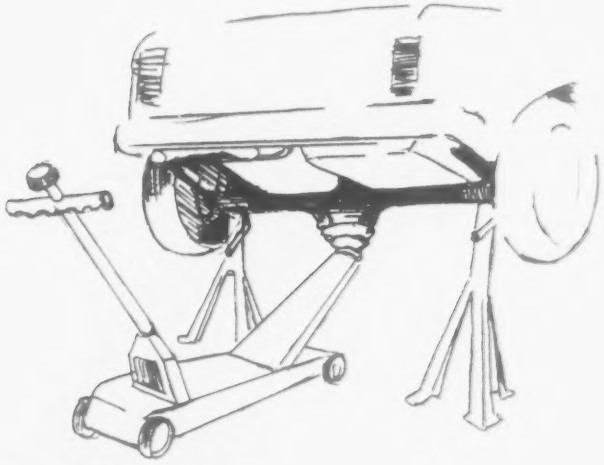


2. A pneumatic jack is an important piece of shop equipment. Some shops have pneumatic jacks that can raise a car by either the bumper or the axle. Special instruction is required prior to using pneumatic jacks. Never work under a vehicle supported only by a jack. Before the technician can work under a vehicle supported by a jack, the vehicle must be lowered onto jack stands. The proper placement of these stands is critical to the safety of the technician. Consult the instructor when placing jack stands. The instructor may suggest that a repair manual be consulted for the proper jack stand locations.

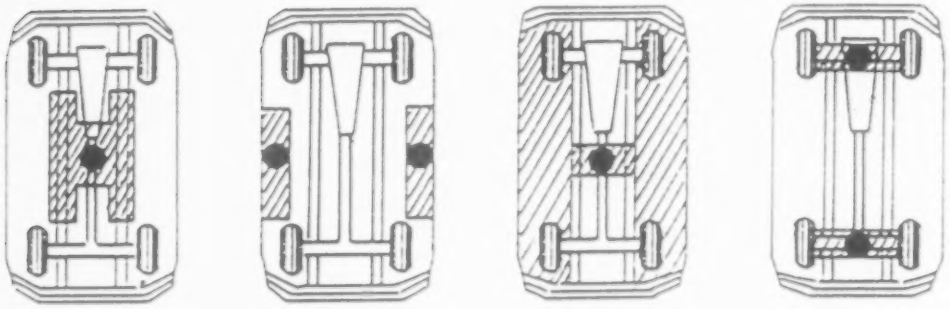


B. Hydraulic equipment develops pressure as a result of the closing of a valve and the pumping of a handle or as a result of a combination of air pressure over hydraulic fluid.

1. The floor jack has a cylinder that raises a vehicle when a handle is pumped. The floor jack should only be used after thorough instruction. The vehicle must be supported on jack stands before anyone gets under the vehicle.



2. The lift rack is a device capable of raising the entire vehicle. Most lift racks use air pressure to pressurize hydraulic fluid, which is then pumped into one or more large cylinders. Always consult the instructor before using the lift rack.

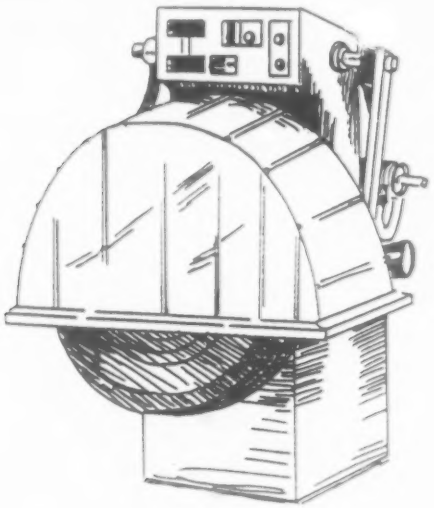


3. A hydraulic press is found in most shops. The hydraulic press is used to press bearings and gears onto and off shafts. Consult the instructor for the procedure for properly setting up and using the hydraulic press. Be sure to wear eye and face protection when working with the hydraulic press.

4. The engine hoist (also called a cherry picker) is used to raise heavy engines and transmissions. After turning a valve, a handle is pumped to raise the hoist. The engine hoist is not intended to support an engine while it is being serviced. The engine should be mounted onto an engine stand during service. Always keep arms and legs from getting underneath the engine, and be sure a suitable chain or strap and bolts are used to hold the engine. Always consult the instructor before using the engine hoist.

C. Electrical equipment

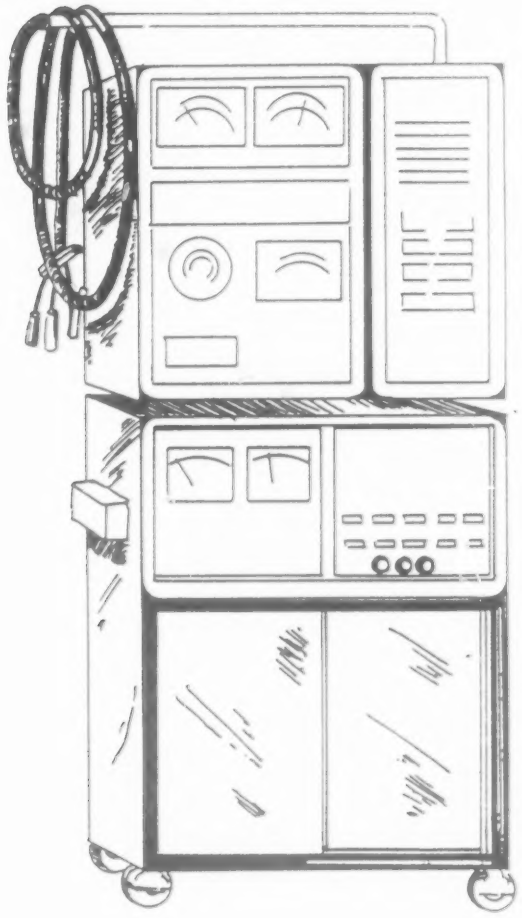
1. Shops equipped to mount tires will have some type of wheel balancer. (Many shops now use computerized wheel balancers.) The student must receive thorough instructions before using the wheel balancer.



2. A bench grinder is a common piece of shop equipment. An automotive shop may have several grinders. These grinders are usually powered by electric motors. The grinders are often mounted on the work bench. In addition to the grinding wheel, the grinder usually has a wire wheel, which is used for cleaning rust and dirt off parts. A safety shield must be properly positioned when the grinder or wire wheel is used. In addition, the technician should wear a full face shield over safety glasses when using the grinder. When grinding small parts, never attempt to hold the parts by hand. The parts can become very hot and can be easily propelled through the air by the wheel. Use vise-grip pliers to hold small parts.

3. Some shops will have a drill press for drilling metal parts. As with bench grinders, wear a full face shield and safety glasses when using a drill press. Also, parts drilled by the press must be securely held by a vise or vise-grip pliers. This prevents the work from spinning out of control and cutting hands. When using the drill press, the technician should not wear loose clothing, jewelry, or allow long hair to hang freely.

4. A variety of sophisticated test and service equipment can be found in the automotive repair shop. Such equipment usually includes battery testers and chargers, ignition analyzers, and front-end alignment equipment. Each piece of equipment has its unique safety considerations. The student should use such equipment only after thorough instruction.



MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT IV: POWER TOOLS AND SHOP EQUIPMENT

UNIT IV TEST

PART I. POWER TOOLS

SECTION A. **Read the statements below. Place a T or F in the blank beside each statement to indicate whether it is true or false.**

____ 1. Use of power tools can speed the repair process.

____ 2. Pneumatic tools use compressed oxygen for power.

____ 3. Line pressure for automotive pneumatic tools should usually run above 400 psi.

____ 4. Air impact guns use a 3/8" or 1\2" drive size for automotive work.

____ 5. Torque of 250 foot pounds or more can be provided by an air impact gun.

____ 6. Air hammer attachments are available for cutting sheet metal and tail pipe.

____ 7. The air impact gun and air ratchets can both produce over 250 foot pounds of torque.

____ 8. An air drill can be used for removing gasket material.

____ 9. The tire burnishing tool is used to heat tire rubber in order to aid the application of tire patches.

____ 10. Hydraulic tools are usually part of the mechanic's hand tool set.

____ 11. A flashlight is usually the best device for providing illumination under the hood or dash of a car.

____ 12. Pneumatic jacks can lift a vehicle either by the bumper or axle.

____ 13. The technician can safely work under a vehicle supported only by a pneumatic jack.

____ 14. In some cases, hydraulic equipment uses air pressure and hydraulic pressure.

____ 15. Jack stands should be used to support the vehicle even if the jack is already under the vehicle.

____ 16. When using the bench grinder, the technician should use the proper tool to hold small parts.

SECTION B. **Select the best answer from the five choices listed.**

____ 17. Pneumatic devices can cause

a. metal chips to fly.
b. tool breakage.
c. infection of the technician.
d. dangerous noise level.
e. all the above.

____ 18. A tool that can easily melt plastic or rubber auto parts is the

a. air wrench.
b. electric drill.
c. drop light.
d. electric ratchet.
e. none of the above.

____ 19. Electrical equipment uses a three-prong plug in order to

a. power the equipment.
b. protect the user from electrocution.
c. protect the equipment from overload.
d. protect the operator from eye hazards.
e. accomplish none of the above.

____ 20. Compressed air is likely to cause a fatality if

a. used to dry wet components.
b. air pressure falls below 25 psi.
c. used out of doors in low temperatures.
d. forced into the blood stream.
e. used in the vicinity of electrical equipment.

____ 21. The risk of hearing damage in the shop can best be minimized by

a. working out of doors whenever possible.
b. using ear plug and/or ear muffs.
c. avoiding the use of loud equipment or tools.
d. using power tools only once a day.
e. doing all of the above.

____ 22. Air blow guns should have a line pressure of about

a. 200 psi.
b. 150 psi.
c. 100 psi.
d. 50 psi.
e. none of the above.

____ 23. Electric power tools should be checked for

a. frayed cord.
b. broken ground prongs.
c. bare wires.
d. proper ground terminal.
e. all the above.

____ 24. When flying metal chips pose a hazard,

a. eye protection is necessary.
b. face protection is necessary.
c. protective clothing is necessary.
d. gloves are necessary.
e. all the above are necessary.

____ 25. Hydraulic tools present

a. a significant noise hazard.
b. a significant electric shock hazard.
c. a significant fire hazard.
d. a significant asphyxiation hazard.
e. none of the above hazards.

(NOTE: The student's score on Part I of the Unit IV Test will be his or her final evaluation for Competency A3. A score between ____ and ____ = 3; a score between ____ and ____ = 2; a sore between ____ and ____ = 1, and a score lower than ____ = N.)

PART II. SHOP TOOLS

SECTION A. Read the statements below. Place a T or F in the blank beside each statement to indicate whether it is true or false.

____ 26. The tire machine is an example of pneumatic equipment.

____ 27. Split rims should not to be repaired without a tire cage.

____ 28. The student must receive thorough training before using a tire machine.

____ 29. The technician should always wear eye protection when using the tire machine.

____ 30. The lift rack can lift the entire vehicle.

____ 31. Lift racks use large cylinders to lift vehicles.

____ 32. The technician should wear eye protection when using the hydraulic press.

____ 33. The engine hoist or cherry picker should not to be used to support the engine while it is being serviced.

____ 34. When using the drill press, the technician should not wear loose clothing, jewelry, or allow long hair to hang freely.

(NOTE: The student's score on Part II of the Unit IV Test will be his or her final evaluation for Competency A6. A score between ____ and ____ = 3; a score between ____ and ____ = 2; a sore between ____ and ____ = 1, and a score lower than ____ = N.)

ANSWERS TO UNIT IV TEST

1. t
2. f
3. f
4. t
5. t
6. t
7. f
8. t
9. f
10. f
11. f
12. t
13. f
14. t
15. t
16. t
17. e
18. c
19. b
20. d
21. b
22. d
23. e
24. e
25. e
26. t
27. t
28. t
29. t
30. t
31. t
32. t
33. t
34. t

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT V: SAFETY CLOTHING AND EQUIPMENT

UNIT OBJECTIVE

After completing this unit, the student should be able to identify protective clothing and equipment and their proper use; proper shop behavior; principles of fire safety; and federal regulations concerning hazardous material and shop safety. The student will demonstrate mastery of the material by achieving a score of _____ on the unit test.

SPECIFIC OBJECTIVES

After completing the lessons in this unit, the student should be able to:

Lesson 1.

I. Identify the considerations in the selection of individual protective clothing and equipment (Competency A4, Part I of the Unit V Test).

II. Identify the dangers of improper behavior in the shop (Competency A4, Part I of the Unit V Test).

III. Identify the reasons why proper grooming and hygiene are important (Competency A4, Part I of the Unit V Test).

Lesson 2.

I. Identify the different classes of fires and the proper fire extinguisher to use for each class of fire (Competency A5, Part II of the Unit V Test).

II. Identify the procedures for the use of a fire blanket (Competency A5, Part II of the Unit V Test).

III. Identify fire emergency procedures (Competency A5, Part II of the Unit V Test).

Lesson 3.

I. Identify the different areas of OSHA regulations (Competency A7, Part III of the Unit V Test).

II. Identify the different areas of EPA regulations (Competency A7, Part III of the Unit V Test).

ASE TASKS COVERED IN THIS UNIT

I. Only material that is preliminary to ASE tasks appears in this unit; therefore, no ASE tasks are covered directly.

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT V: SAFETY CLOTHING AND EQUIPMENT

CONTENTS OF THIS UNIT

A. Objective sheet

B. References

C. Lesson plans

1. Lesson 1: PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

   a. Information outline

2. Lesson 2: FIRES AND FIRE EXTINGUISHERS

   a. Information outline

3. Lesson 3: FEDERAL AND STATE AGENCY REGULATIONS

D. Unit test

E. Answers to unit test

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MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT V: SAFETY CLOTHING AND EQUIPMENT

LESSON 1: PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

(NOTE: Personal protective clothing and equipment should not be considered the first line of defense against injury, but rather as back-up protection.)

I. Considerations in the selection of individual protective clothing and equipment

A. The technician should develop a thorough understanding and appreciation of personal protective clothing and equipment.

1. Before performing a task, always consider the relevant safety precautions related to that task. Think of all the possible hazards involved in performing the task and formulate a prevention plan for each hazard.

2. Select the tool or piece of equipment that will handle the job in the safest and most efficient manner. Never use a tool for anything other than its intended purpose.

3. Before using a tool or piece equipment, inspect it for defects, missing or improperly adjusted safety guards, or any other missing or malfunctioning safety devices. If a problem exists, consult the instructor before using the tool or piece of equipment.

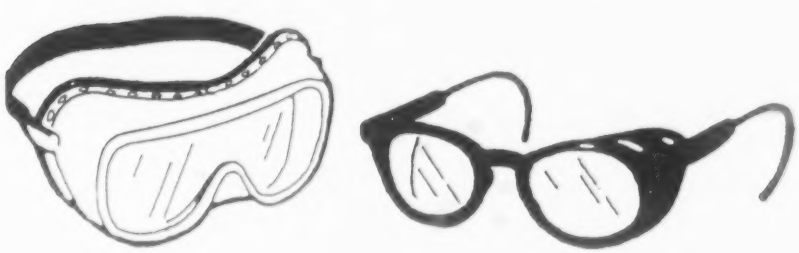
4. Maintain and store tools and equipment properly. Develop a regular maintenance schedule for shop equipment. Discard, repair, or replace worn tools.

5. Maintain a clean and orderly shop environment. All tools, equipment and parts should have a designated place where they can be safely stored. Always return items to their designated storage area after use. Do not allow the working environment to become cluttered. Clean up spills immediately.

6. Work with others to ensure all safety precautions are followed. Consult the instructor about any safety concerns.

B. Selecting and using the correct type of protective clothing and equipment

1. One of the best starting points for establishing the habit of using protective equipment is to wear appropriate eye protection at all times in the shop area. The law requires that eye protection must be available and worn in vocational education courses where there is a reasonable probability of injury.



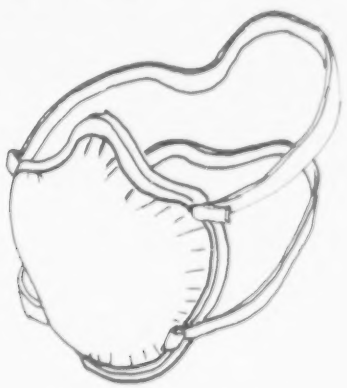
a. Chemical hazards are present in areas where chemical spraying, chemical cleaning, and the application of hazardous chemicals occur. Special splash-resistant goggles should be worn in these areas.

b. Light-duty glare typically occurs with gas welding and strong sunlight. Spectacles or goggles that conform to specifications in regard to tint are a vital and necessary means of eye protection when the technician is exposed to the rays of light-duty glare or strong sunlight. Consult the instructor for the appropriate tint goggles for welding operations.

c. Impact hazard areas include areas where grinding, drilling, chipping, heavy machinery, buffing, or polishing occur. Proper glasses and wire mesh goggles or plastic spectacles with side shields are required in impact hazard areas. These goggles must comply with regulating codes Mo. 170.005 and Mo. 170.007.

d. Every person, including all students and visitors, must wear eye protection at all times in the shop area. Only protective eye wear of industrial quality as specified by the American National Standards Institute (ANSI) should be worn. The ANSI standards cover such important features of protective eye wear as lens thickness, lens retention, optical quality, flame resistance of the frame, ability to be sterilized, warp resistance, and other such characteristics.

2. Respiratory protection is sometimes necessary in the automotive shop. Respiratory devices consist of a mesh that covers the nose and mouth. The technician should wear a respiratory mask when doing such tasks as grinding and sanding if a rust or paint dust will be created.



3. If noise levels exceed the 90dBA (decibel) limit, damage to hearing will occur. Many things in the shop (e.g. air hammers, grinders, engines, and compressed air devices) create loud noise. Ear plugs significantly reduce the noise that reaches the eardrum and, therefore, offer adequate protection. Ear muffs can also be worn for protection from noise.

4. Students must always wear adequate footwear in the shop area. The foot can easily be crushed by heavy weight or cut and punctured in the shop environment. Such injury can be prevented by wearing the proper footwear. Shop footwear should have leather or rubber oil-resistant soles. The footwear should also provide a full leather or strong fabric cover for the entire foot up to the ankles. Footwear with steel-reinforced toes provides even more protection for the foot.

5. Proper protective clothing for the body and hands will not only reduce the hazard of injury, but also protect street clothing as well. Clothing worn in the shop should be comfortable (but not loose), machine washable, wear resistant, fire resistant, and heavy enough to provide protection from chips and sparks.

   a. Gloves and hand leathers are important pieces of protective clothing. If the main hazard is blisters due to friction, cotton work gloves are usually adequate. Welding, however, requires leather gloves that extend well over the wrist. Rubber gloves must be worn when working with caustic chemicals.

      (**CAUTION:** Gloves should usually not be worn while operating machines other than a welding apparatus.)

   b. Aprons (which can be made from a variety of materials) are used to protect the technician from sparks, hot metal splashes, and splashing liquids. The material should be suitable for the intended use.

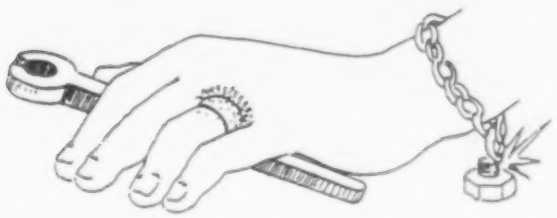
      (**CAUTION:** Never wear loose aprons around revolving or reciprocating machinery.)

   c. Coveralls protect the body (though they do not usually protect the hands, head, and feet). A variation of the coverall, the overall, includes a "bib", but does not have sleeves as do coveralls. The material from which coveralls or overalls are made must be rugged and able to withstand wear. Coveralls and overalls are recommended for people enrolled in auto mechanics training programs.

   d. Shop coats primarily provide protection against dirt and grease that would soil street clothing. Shop coats can also offer some protection against chemicals and hot substances.

6. Rings, watches, necklaces, and other forms of jewelry must never be worn in the automotive shop.

   a. Two hazards are associated with the wearing of rings. The first is the possibility of burns. When a mechanic grips a wrench, a ground circuit is made from the ring, through the wrench, to the bolt, which is grounded. If the wrench or ring touches the positive side (hot) of a circuit, the electricity will flow through the ring in a short circuit. This will cause the ring to heat up, possibly to a glowing red. The other possibility is that, when a heavy object is lifted, it may slip slightly and catch on the ring. This can easily result in the loss of a finger.



   b. The hazards of watches and bracelets are similar to those of rings.

   c. A dangling necklace can easily become entangled in running machinery, pulling the mechanic into the machinery and causing great bodily harm.

II. The dangers of improper behavior in the shop

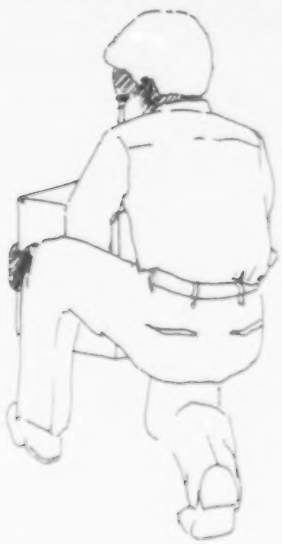
(NOTE: Few occupations expose the worker to the amount of dangerous equipment as does the auto mechanics repair field. Immature and improper behavior causes many serious accidents and injuries. Even death has occurred as a result of student horseplay. Horseplay has no place in auto mechanics. Listed below are common hazards found in an auto mechanics shop.)

A. There are many sharp edges on shop equipment. A person can be severely cut if he or she slips or falls on one of these sharp edges.

B. Shop floors are almost always concrete, which means they are hard and often slippery. Running and horseplay are open invitations to severe bumps and bruises caused by falls.

C. The typical automotive repair shop will have a great deal of solvents, gasoline, and flammable gasses. A fire in an automotive shop would have catastrophic consequences.

D. Technicians work underneath cars supported on jack stands or lift racks. The weight of these items makes them very dangerous. In addition, the technician must frequently lift and handle heavy objects. The technician should never lift with his or her back. When lifting heavy objects, the technician should bend his or her legs and squat. Doing so will reduce the chances of disabling back injuries.



RIGHT

WRONG

E. Improper behavior can result in expensive damage to cars and test equipment in the shop.

F. Always consult the instructor before moving a vehicle. Make sure a vehicle is mechanically ready to be driven before moving it. Always drive vehicles in a mature and safe manner.

III. The importance of proper grooming and hygiene

(NOTE: While proper grooming and hygiene are primarily associated with employability, improper grooming and hygiene can have negative safety consequences as well.)

A. Though long hair may be fashionable, it can easily become entangled in moving machinery. If a technician's long hair becomes caught in machinery, he or she may lose a portion of scalp or be pulled into the machinery. An automotive technician's hair should not exceed shirt-collar length.

B. As previously mentioned, loose and dangling clothing or jewelry can become entangled in machinery.

C. Greasy hands can slip when the technician is working with hand tools. Such slipping can result in injuries. In addition, grease can soil auto interiors and paint. Greasy fingerprints are the trademark of the incompetent mechanic. Remember, too, that brake fluid and other chemicals on the hands can destroy painted surfaces.

D. Greasy work shoes spread grease across the shop floor (and vehicle interiors), thus increasing the risk of slipping and falling. Dirty and greasy coveralls can ruin a vehicle's interior.

E. Dirty and scratched eye protection is difficult to see through and therefore dangerous. Keep safety lenses clean and never place the glass lenses down on the floor or table. The soft plastic coating can become scratched quite easily.

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT V: SAFETY CLOTHING AND EQUIPMENT

LESSON 2: FIRES AND FIRE EXTINGUISHERS

I. The four classes of fires and the type of fire extinguisher which should be used to put out each class of fire

(NOTE: Although every precaution should be taken to prevent fires, there is always a possibility that a fire will occur. Therefore, it is necessary to know what type of extinguisher is used to put out a certain type of fire.)

A. Class A fires include burning paper, wood, rubber, cloth, and many other materials commonly found in most classrooms and offices. These fires may be effectively handled with either a dry-chemical or a water-type fire extinguisher.

1. A water-type fire extinguisher weighs about 20 lbs.

2. A dry-chemical fire extinguisher is commonly found in automotive shops. The dry-chemical fire extinguisher does an effective job of putting out fires. A dusty residue will be left over after the extinguisher is used and must be cleaned up immediately after the fire is extinguished. If not properly cleaned up, the dusty residue may harm those items which it covers.

B. Class B fires include burning liquids and gasses, grease, and oil. Only dry-chemical fire extinguisher should be used on Class B fires. Do not use water or a water-type fire extinguisher. Water will likely cause the burning liquid to spread.

C. Class C fires are electrical fires. Before using a fire extinguisher on a Class C fire, make sure the extinguisher has the Class C symbol. Class C extinguishers usually use dry chemicals and carbon dioxide. Never use water or foam-type extinguishers on Class C fires. Using water or foam on Class C fires can easily electrocute people in the area.

D. Class D fires include burning metals, such as magnesium or sodium. Since these metals are uncommon in the automotive field, Class D fires are less likely to occur than the other classes of fires. Class D fire extinguishers are identified by a 5-pointed star with the letter "D" printed within the star. Use only a Class D fire extinguisher on Class D fires.

(NOTE: Most shops use multiple class fire extinguishers which can be used on A, B, and C class fires.)

II. Every automotive training shop must have a 100% wool fire blanket. The fire blanket can be wrapped tightly around a person who is on fire in order to smother the flames. Avoid using a fire blanket on a burning person wearing synthetic clothing. Doing so can cause serious skin damage. Use water to extinguish burning clothing that is made of synthetic material. Because synthetic material is particularly dangerous when it burns, work coveralls and shop clothing should be made of cotton.

(**CAUTION**: Do not allow a person on fire to run.)

III. General fire emergency procedures

(NOTE: Specific procedures for dealing with fire emergencies may vary from shop to shop; therefore, ask the instructor for procedures that are more detailed than those listed below.)

A. Take immediate action if a person is on fire.

B. Turn on the fire alarm.

C. Notify the instructor as soon as possible. The instructor may decide whether extinguishment should be attempted.

D. Turn off machines and power in the event of an alarm.

E. Follow building evacuation procedures.

(NOTE: Consult the instructor regarding the location of all shop fire extinguishers. Be sure to know the location of all shop fire extinguisher and be able to find them at a moment's notice. Be sure to know the types of fires each extinguisher can handle.)

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT V: SAFETY CLOTHING AND EQUIPMENT

LESSON 3: FEDERAL AND STATE AGENCY REGULATIONS

I. OSHA regulations

(NOTE: The Occupational Safety and Health Association, commonly referred to as OSHA, is a federal organization, which sets and enforces work environment standards to protect the health and safety of the individual worker. Any employer or institution that does not adhere to OSHA standards is subject to prosecution.)

A. If employees provide their own eye and face protective equipment (as is often the case in most automotive shops), OSHA requires that the employer make sure the equipment is adequate.

B. OSHA requires the employer to provide a ventilation system, masks, and any other such devices needed to provide reasonable protection against harmful dusts (such as brake and clutch asbestos dust), fogs and fumes (such as engine exhaust), mists, gasses, smokes, sprays, and vapors.

C. OSHA requires that flammable liquids (such as gasolines and solvents) that are packaged or kept in small containers be stored in an approved metal cabinet in quantities of less than 60 gallons. The metal cabinets are approved by Underwriters Laboratories.

D. OSHA requires that, when potentially hazardous chemicals (which includes a wide variety of automotive products) are stored on site, the employer must keep them clearly labeled and explain the dangers and correct uses to the workers. Automotive technicians now receive a comprehensive safety training course which addresses the correct procedures for chemical handling, storage, and disposal.

E. OSHA requires that the employer provide adequate ear protection to all workers exposed to high noise levels. The exact level and frequency of noise which can be harmful is defined in great detail by OSHA. Electronic test equipment is usually required to evaluate noise levels. In the automotive shop, noise can reach levels that OSHA identifies as harmful to hearing. Ear plugs are an inexpensive and effective form of hearing protection for the automotive technician.

II. EPA regulations

(NOTE: The Environmental Protection Agency, commonly referred to as the EPA, is a federal and state organization that writes and enforces regulations for the production of hazardous waste by businesses. The EPA is responsible for the manner in which the health of the population is affected by the environment. Any business that creates more than 100 kg. (or about 220 lbs.) of hazardous waste per month is subject to these regulations. This amount is roughly equivalent to only 1/2 barrel (55 gal. size) of drain oil or solvent, both of which are considered hazardous waste. The typical automotive shop will collect this amount of drain oil or solvent in one month. Thus, almost every automotive shop is classified as a "small quantity generator" of hazardous waste material by the EPA. The important regulations pertaining to the handling, storage, and disposal of hazardous material are listed below.)

(NOTE: Lead-acid batteries are another form of hazardous waste commonly found in the automotive shop.)

A. EPA regulations related to the storage of hazardous waste

1. EPA regulations prohibit the mixing of different types of hazardous waste.

2. EPA regulations require that storage containers be in sound condition and have the proper design and characteristics for the type of material to be stored.

3. EPA regulations require that containers be clearly marked and stored away from the shop area. The EPA and DOT (Department of Transportation) require that specific labels be used to indicate various types of waste.

4. EPA regulations allow the shop to collect no more than 6000 lbs. of waste in a one-month period.

5. EPA regulations allow hazardous material to be stored no longer than 180 days.

B. EPA regulations related to handling hazardous waste

1. EPA regulations require employees to be trained in the proper use and disposal of hazardous waste.

2. EPA regulations require that signs and charts identifying and describing hazardous material be displayed in the shop. The regulations also require that emergency procedures for dealing with hazardous waste accidents be displayed in the shop. In addition, the phone numbers of the emergency coordinator (the person in the shop selected to handle emergency situations), fire department, police, health center, and the national response center (the EPA agency equipped to deal with emergencies related to hazardous materials) must be posted by the telephone.

3. EPA regulations require that the shop work area be uncluttered and that exits be easily accessible. The local fire marshall determines if the shop is meeting these requirements.

4. EPA regulations require that the shop operator have on file precise information on the chemicals contained in each product in the shop. The operator should also have on file first aid procedures relating to exposure to these chemicals.

C. EPA regulations related to the disposal of hazardous waste

1. EPA regulations require that hazardous waste be collected by an approved waste hauler.

2. EPA regulations require that a shop representative fill out a waste manifest each time a waste hauler picks up hazardous material. The hauler cannot accept waste without the correct forms. One exception to this rule involves the use of solvents that will be recycled by the waste hauler. In this case, the paperwork is handled by the hauler.

3. EPA regulations require that the shop obtain a twelve-digit code number from the United States EPA. This number registers the shop as a small-quantity generator of hazardous waste. A waste hauler cannot accept waste from the shop without this code.

4. EPA regulations require that each type of waste be in a suitable package or container and identified with a code name as specified by the Department of Transportation (DOT).

5. Failure to observe EPA regulations will result in criminal liability to the shop or waste hauler.

D. Exactly what chemicals or products are designated as hazardous waste can change over time. In 1986, for example, drain motor oil was not considered hazardous. Later the EPA did designate waste oil as a hazardous waste. The two means by which a material can be judged "hazardous" and be subject to EPA regulation are listed below.

1. The EPA publishes a list which is periodically updated that names specific chemicals deemed to be hazardous to health and the environment.

2. If a shop operator has reason to believe that a material is flammable or corrosive, or if the operator thinks a material will react chemically with other materials or will release hazardous material, then that material is usually deemed to be hazardous and subject to EPA regulations.

   (NOTE: In August of 1989, the EPA removed automobile antifreeze, which is ethylene glycol based, from its list of hazardous chemicals. Automobile antifreeze can now be disposed of in conventional ways.)

E. Listed below are several ways in which the automotive shop can reduce the production of hazardous waste and the cost of disposing of it.

1. Automotive technicians often use more solvent for a job than necessary or discard solvent that still has the ability to clean some types of parts. By using solvent conservatively, the shop can reduce waste disposal costs as well as the replacement costs of solvent.

2. Many automotive shops have heaters that burn drain oil, thus saving on heating bills as well as waste disposal costs.

3. The shop is usually not required to fill out a waste manifest if the shop ships the hazardous waste directly to a recycling plant. For example, the shop might ship an old car battery to a used-lead smelting plant or ship solvent to a recycling distillation plant. In many cases, recycling plants will pick these items up at no charge.

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT V: SAFETY CLOTHING AND EQUIPMENT

UNIT V TEST

PART I. PROTECTIVE EQUIPMENT AND GENERAL SAFETY

SECTION A. **Read the statements below. Place a T or F in the blank beside each statement to indicate whether it is true or false.**

____ 1. A technician wearing dirty overalls can ruin car interiors.

____ 2. When grinding metal, the technician must wear eye protection and respiratory protection.

____ 3. Noise levels over 90 decibels can ca[illegible]aring damage.

____ 4. Sandals with oil resistant soles are a [illegible] footwear choice for the shop.

____ 5. Rings, watches, necklaces, and other forms of jewelry are not to be worn in the automotive shop.

____ 6. Technicians commonly work under vehicles not supported by safety stands.

____ 7. Vehicles should be moved in a mature manner.

____ 8. Long hair in the shop is a safety hazard.

____ 9. A technician should keep his fingers greasy in order to appear busy.

____ 10. Safety glasses will seldom be harmed if they are dropped on the floor.

____ 11. The technician should consider all safety concerns before performing a job.

____ 12. Maintaining tools helps prevent personal injury.

____ 13. Playfulness and horseplay have no place in the automotive shop.

____ 14. A fall in the shop can cause bumps, bruises, and cuts.

____ 15. Strong men and women do not have to use their legs to lift heavy objects.

____ 16. Before moving any vehicle, always check with the instructor.

(NOTE: The student's score on Part I of the Unit V Test will be his or her final evaluation for Competency A4. A score between ____ and ____ = 3; a score between ____ and ____ = 2; a sore between ____ and ____ = 1, and a score lower than ____ = N.)

PART II. FIRE SAFETY

SECTION B. Select the best answer from the five choices listed.

____ 17. A fire that involves the burning of gasoline, oil, or grease is a

a. Class A fire.
b. Class B fire.
c. Class C fire.
d. Class D fire.
e. Class E fire.

____ 18. A fire that involves common combustibles such as wood or paper is a

a. Class A fire.
b. Class B fire.
c. Class C fire.
d. Class D fire.
e. Class E fire.

____ 19. An electrical fire is a

a. Class A fire.
b. Class B fire.
c. Class C fire.
d. Class D fire.
e. Class E fire.

____ 20. The fire blanket is usually made of

a. cotton.
b. nylon.
c. synthetic material.
d. wool.
e. none of the above.

____ 21. Class B fires are usually fought with

a. water hoses.
b. foam extinguisher.
c. soda/water extinguisher.
d. dry chemical extinguisher.
e. none of the above.

____ 22. Water can be used to fight

a. Class A fires.
b. Class B fires.
d. Class C fires.
c. Class D fires.
e. Class E fires.

____ 23. The most common type of fire extinguisher in an auto shop is an

a. ABC water extinguisher.
b. ABC foam extinguisher.
c. ABC carbon dioxide extinguisher.
d. ABC dry chemical extinguisher.
e. ABC soda acid extinguisher.

____ 24. The class of fire that is most unlikely to occur in the auto shop is the

a. Class A fire.
b. Class B fire.
c. Class C fire.
d. Class D fire.
e. Class E fire.

(NOTE: The student's score on Part II of the Unit V Test will be his or her final evaluation for Competency A5. A score between ____ and ____ = 3; a score between ____ and ____ = 2; a sore between ____ and ____ = 1, and a score lower than ____ = N.)

PART III. EPA REGULATIONS

SECTION A. **Read the statements below. Place a T or F in the blank beside each statement to indicate whether it is true or false.**

____ 25. EPA regulations state that employers are responsible for the adequacy of eye protection equipment.

____ 26. EPA regulations state that an employer must provide reasonable respiratory protection for employees.

____ 27. EPA regulations state that gasoline and solvents must be stored in approved containers in metal cabinets and in quantities less than 50 gallons.

____ 28. EPA regulations state that hazardous materials must be clearly labeled.

____ 29. EPA regulations state that employers are required to provide adequate hearing protection for employees.

____ 30. EPA regulations state that hazardous material can be mixed for disposal.

____ 31. EPA regulations state that hazardous material cannot be stored at the shop longer than 180 days.

____ 32. EPA regulations state that work areas must have easy access to exits.

____ 33. EPA regulations state that the EPA determines what chemicals are hazardous.

____ 34. EPA regulations state that conservation of hazardous materials is a good way to ease the burden of hazardous waste disposal.

(NOTE: The student's score on Part III of the Unit V Test will be his or her final evaluation for Competency A7. A score between ____ and ____ = 3; a score between ____ and ____ = 2; a sore between ____ and ____ = 1, and a score lower than ____ = N.)

ANSWERS TO UNIT V TEST

1. f
2. t
3. t
4. f
5. t
6. f
7. t
8. t
9. f
10. f
11. t
12. t
13. t
14. t
15. f
16. t
17. b
18. a
19. c
20. d
21. d
22. a
23. d
24. b
25. f
26. f
27. f
28. f
29. f
30. f
31. t
32. t
33. t
34. f

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT VI: SHOP OPERATION

UNIT OBJECTIVE

After completing this unit, the student should be able to identify procedures which improve customer relations as well as use a labor and parts guide to write a repair order. The student will demonstrate mastery of the material by achieving a score of _____ on the unit test and successfully performing specific tasks.

SPECIFIC OBJECTIVES

After completing the lessons in this unit, the student should be able to:

Lesson 1.

I. Identify proper customer relation procedures (Competency B1, AS2-L1-UVI).

II. Identify the important information needed to write a repair order (Competency B1, AS2-L1-UVI).

III. Identify the information needed to estimate labor charges (Competency B2, AS1-L1-UVI).

IV. Identify the information needed to order parts (Competency B1, AS2-L1-UVI).

Lesson 2.

I. Identify the different sources of vehicle repair procedures (Competency B3, AS1-L2-UVI).

Lesson 3.

I. Identify why shop cleanliness and orderliness are important (Competency B4, Part III of the Unit VI Test).

II. Identify the procedures for maintenance and repair of the shop facilities and equipment (Competency B4, Part III of Unit VI Test).

ASE TASKS COVERED IN THIS UNIT

I. Only material that is preliminary to ASE tasks appears in this unit; therefore, no ASE tasks are covered directly.

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT VI: SHOP OPERATION

CONTENTS OF THIS UNIT

A. Objective sheet

B. References

C. Notes to the instructor

D. Lesson plans

1. Lesson 1: REPAIR ORDERS AND CUSTOMER RELATIONS

   a. Information outline

   b. Assignment sheets

      AS1-L1-UVI: Using the Parts and Labor Estimation Guide to Determine the Cost of a Needed Repair
      AS2-L1-UVI: Writing a Repair Order

2. Lesson 2: SERVICE AND LABOR MANUALS

   a. Information outline

   b. Assignment sheet

      AS1-L2-UVI: Obtaining Repair Procedure Information from a Shop Repair Manual

3. Lesson 3: SHOP CLEANLINESS AND MAINTENANCE

E. Unit test

F. Answers to unit test

REFERENCES

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Missouri Division of Career and Adult Education. Vocational Safety Guide. 1981.

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Stockel, Martin. Auto Mechanics Fundamentals. 5th ed. South Holland, Illinois: The Goodheart-Willcox Company, Inc., 1982.

Stockel, Martin and James Duffy. Workbook for Auto Mechanics Fundamentals. South Holland, Illinois: Goodheart-Willcox Company, Inc., 1982.

NOTES TO THE INSTRUCTOR

A. Suggested approaches to teaching this unit

1. Note that students must receive an acceptable score (decided upon by the instructor) on Part I, Part II, and Part III of the Unit VI test before they can receive a final evaluation on Competency B1, Competency B2, and Competency B3 respectively.

2. AS1-L1-UVI and AS2-L1-UVI involve the use of a parts and labor estimation guide and service manuals. Because the design of these guides and manuals vary, it is suggested that the instructor teach students the use of estimation guides and service manuals based upon the materials found in the shop. Note that the instructions for AS1-L1-UVI and AS2-L1-UVI call for the instructor to provide the students with descriptions of specific repairs.

3. AS2-L1-UVI includes a generic repair order which students are to fill out. If a more suitable repair order is available, feel free to substitute it for the one on AS2-L1-UVI.

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT VI: SHOP OPERATION

LESSON 1: REPAIR ORDERS AND CUSTOMER RELATIONS

I. Proper customer relation procedures

(NOTE: It is an unfortunate fact that many automotive technicians and repair shops do not elicit positive feelings from their customers. If the behavior of the technician and other workers in the shop leaves the customer with a negative impression, the financial stability of the shop can be in jeopardy. Technicians who do not act properly when dealing with customers degrade the image of all workers in the automotive profession. Behaving professionally toward customers and fellow workers can also help the technician achieve career success. Studies have shown that, in all occupations, more people are fired for their inability to get along with others than for a lack of technical expertise. Listed below are characteristics of courteous and professional behavior.)

A. All workers in the automotive shop, including the technician, should greet the customer when appropriate and act in a friendly, courteous manner. Automobile repair work can often be quite frustrating. The technician may be tempted to express this frustration in a curt, unfriendly demeanor, which creates negative feelings in the customer. Be sure to leave problems under the hood and greet the customer with a friendly smile. Refer to the customer by using the proper surname Mr. or Ms. and his or her last name.

B. The technician should always listen carefully. People communicate at different paces and in different styles. The customer is likely to be upset by the fact that the vehicle he or she depends upon is unavailable and that the repair may be expensive. Listen carefully and patiently. After the customer has explained the problem, ask questions that may help in the diagnosis.

C. The technician should always verify the complaint. Verifying the complaint may mean test driving the car, possibly with the customer along. Drive safely and always exhibit a professional attitude. The verification of the complaint is extremely important. Some customers will unknowingly give you a false diagnosis (for example, the customer may say the vehicle needs a tune-up while some other service procedure may be required). The technician should be sure that he or she is perceiving the same problem as the customer.

D. The technician should give the customer an estimate. Few things are more upsetting to a customer than being presented with a large repair that they did not expect. Be sure to get the customer's phone number when filling out the repair order. Call the customer before doing any unapproved repairs.

E. The technician should always be on the lookout for problems other than those described by the customer. Rarely is the customer an expert on automobile repairs; therefore, his or her description or diagnosis of the problem may well be incomplete or incorrect. Either over the phone or in person, the technician should always explain the problems to the customer in a professional manner. For example, the mechanic might call the customer and say,

> "Mr. Johnson, this is Pam at Gene's Auto Repair. Everything is fine. I'm just completing the tune-up on your car, but I noticed a few things that you may want to have taken care of. The alternator belt is cracked and there is a small leak in the radiator. We can have these things repaired, and if you'd like, I can give you an estimate."

In the above example, the technician has informed the customer of additional problems that need repair and allowed the customer to decide if the additional repairs should be made. Courteous conduct of this type can increase business.

(NOTE: In large repair shops, the service manager usually has the responsibility of calling customers; therefore, the technician may have only occasional contact with customers. Nevertheless, when a technician does have to deal with a customer, the technician should always treat the customer with the utmost courtesy.)

F. The technician should always perform the repair in a professional manner. He or she should never rush a job or replace unnecessary parts (the so-called shotgun approach to repair) in order to save time. Be sure the diagnosis is consistent with the problem and that any replacement parts are of the correct quality. Carefully fit and adjust all replacement parts. Remember that the owner is paying for a repair. Once the car is returned to the owner, he or she will expect the problem to be eliminated.

G. The technician should always work safely and efficiently. The technician should never take chances with his or her health.

H. The technician should verify the repair. Repair verification may involve pressurizing a cooling system to see if a leak has been fixed, or test driving the car to be sure a problem is resolved. One of the most common complaints of car owners is that they paid to have a repair performed only to experience the same problem after the repair is supposed to have been made.

I. The technician should keep the car clean during repairs. Never allow dirty hands or work clothes to soil a vehicle's interior or paint. Use fender covers, seat covers and paper floor protectors during repairs. Wash hands frequently. Remember that greasy hand prints are a sign of an incompetent mechanic.

II. Listed below is information needed to write a repair order.

(NOTE: The repair order serves several functions. It is an authorization by the car owner to have repairs performed. It itemizes the repairs performed and indicates the cost of parts and labor. The order also contains information about how to get in touch with the car owner and serves as documentation for future reference. The order may specify limited warranties and liabilities of the shop. Be sure to collect the following information on the repair order in a neat, legible manner. There is an example of a repair order on page 133.)

A. Customer name

B. Customer address

C. Customer phone number

(NOTE: If the customer works during the day and has no one at home to receive calls or to make decisions about repair, make sure to include a work telephone number and, if necessary, an extension number.)

D. Customer authorization signature

(NOTE: Always obtain the customer's authorization before doing any repairs.)

E. Date

F. Vehicle make, model, year, and engine type

G. Name or initials of the technician

(NOTE: After the repair is made, it may be necessary to determine who wrote the work order.)

H. Description of complaint

I. Technician's notes

(NOTE: The technician should write the results of his or her diagnosis on the repair order in addition to any important observations or remarks.)

J. Listing of parts

(NOTE: The name, description, and price of each part should be listed on the work order.)

K. Labor charge

(NOTE: The labor charge should include a per-hour rate, flat-rate per item, and flat-rate total. See the discussion of flat-rate time in item "III" below.)

L. Outside charges

(NOTE: Occasionally, a shop may send a particular part out to another shop for repairs. The charges for these repairs are called outside charges. Common examples are radiator repair, electronic component repair, or machine work.)

M. Sales tax

(NOTE: Sales tax is usually calculated for parts only.)

N. Total

(NOTE: The total represents the final price that the customer pays for all charges related to the repair.)

(NOTE: See the example of a repair order on page 133.)

III. Many shops calculate the labor charge for a particular job according to standard repair times listed in parts and labor estimation guides. The standard times in these guides are based upon the amount of time required for a skilled technician to complete a particular job. Many technicians are paid according to flat-rate time--that is, the technician is paid according to the amount of time the parts and labor estimation guide lists for a particular repair. There are specific repair time standards for each vehicle model. Ask the instructor to provide examples of parts and labor estimation guides. A further discussion of flat-rate time is found in Unit VII of this module.

IV. Information needed for ordering parts

A. Listed below is information usually included in a repair parts order.

(NOTE: Many automotive technicians order the parts from a parts department, which is located within the shop in which they work. The technician may also order parts from a local parts store. In either case, the technician will have to provide certain information when making a parts order.)

(NOTE: Parts and their prices are usually listed on the repair order.)

1. Vehicle make

2. Vehicle model

3. Model year

a. A vehicle's production date can be found on the driver's door jamb. Due to mid-year model changes, the production date is often valuable in obtaining correct replacement parts. The production date, however, is not always an accurate indication of year model.

b. The vehicle's identification number (VIN) will also indicate the vehicle's model year. Ford vehicles built before 1980 use the first two digits of the VIN number to denote model year. For example, the Ford VIN 4F03Z203349 indicates a 1974 model. General motors and Chrysler vehicles use the 6th digit for models built before 1980. GM VIN 3M57R5R247819 indicates a 1975 model.

c. Domestic cars and trucks built after 1979 use a new system for organizing VIN numbers. In this new system, the tenth item in the VIN number is a letter that represents the model year. For example, the letter A indicates 1980, B indicates 1981, C indicates 1982, and so on. For example, the GM VIN number 1GTCS 14B8D2794223 indicates a 1983 model.

d. The vehicle's owner's manual may be found in the glove compartment. The owner's manual displays the vehicle model and year on the cover.

e. The vehicle's tail light lens may display the last two digits of the vehicle model year (72 for 1972, for example). But, since the manufacturer may use the same tail light lens on succeeding model years (still displaying 72, for example), checking the tail lights is the most unreliable method for the determination of model year.

4. Engine information

a. The parts counter person will often need to know the engine size (in cubic inches or liters), the number of cylinders, and the type of fuel system (carburetor or fuel injection).

b. Most engine information can be obtained from the engine decal.

SMITH BROTHERS AUTO REPAIR

CUSTOMER'S NAME J. Steffensmeier DATE 6/29/90 INVOICE NUMBER 546387

3690 17th Street Columbia, Mo. 445-7035
ADDRESS PHONE

1985 Buick Skylark 2.8L
VEHICLE YEAR/MAKE VEHICLE MODEL MOTOR/VIN NUMBER

SERVICE WRITER J. Smith REPAIR TECHNICIAN F. Smith

CUSTOMER AUTHORIZATION SIGNATURE Jay Steffensmeier

CUSTOMER COMPLAINT
- no high beam on left front headlamp

	ESTIMATED	ACTUAL
LABOR PROCEDURES AND COSTS		
remove and replace headlamp	5.00	5.00
OUTSIDE LABOR PROCEDURES AND COSTS		
TOTAL LABOR COSTS	5.00	5.00
PARTS COSTS		
QTY. PART NO. DESCRIPTION		
1 8001 halogen headlamp	16.00	12.45
TOTAL PARTS COSTS	16.00	12.45
LABOR TOTAL	5.00	5.00
PARTS TOTAL	16.00	12.45
TAX	.64	.50
GRAND TOTAL	$21.64	$17.95

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(NOTE: Depending upon the part being ordered, additional information such as wheelbase and number of doors may be required.)

B. Often a rebuilt or remanufactured parts are available at less cost than new ones. Ask the parts counter person if the quoted price is for new or rebuilt part. If rebuilt parts are ordered, the old part (core) will have to be returned to the parts store. There may be an extra charge if the old part is not returned.

C. It is the responsibility of the technician to compare the new part with the old one and determine if it is a suitable replacement. If any difference is noted between the new part and the old one, consult the parts counter person to be sure the new part is acceptable for its intended application. Always be sure to use the correct part for whatever repair or service is being performed.

(NOTE: Most auto parts stores will not allow electrical parts to be returned. When ordering electrical parts, be as sure as possible of the diagnosis.)

D. If a service shop is a high-volume customer, it may receive a parts discount, sometimes called a dealer's price. Most shops record the regular retail price, called the list price, on the repair order. The list price is usually provided on the invoice form from the parts store. Most repair shops have an account set up with the parts store; therefore, the mechanic will simply need to initial the invoice upon delivery of the parts. The parts store will then bill the repair shop at a later time.

E. In order to provide better service, many parts stores install an inventory of commonly used parts (such as spark plugs and fan belts) into the repair shop. This inventory is called consignment stock. About once a week, the parts store will inventory and replace parts used from this consignment stock and bill the shop accordingly.

MODULE: INTRODUCTION TO AUTO MECHANICS

USING THE PARTS AND LABOR ESTIMATION GUIDE TO DETERMINE THE COST OF A NEEDED REPAIR

Instructions: Either on the board or a separate sheet of paper, the instructor will list two automotive repairs. Using a parts and labor estimation guide, answer the following questions and perform the following tasks.

1. What is the first repair listed by the instructor?

2. On what pages in the parts and labor estimation guide can information required to estimate the cost of parts of the first repair be found?

3. Record below the estimated cost and labor for the first repair.

4. What is the second repair listed by the instructor?

5. On what pages in the parts and labor estimation guide can the information required to estimate the cost of parts and labor for the second repair be found?

6. Record below the estimated cost of parts and labor for the second repair.

(NOTE: Use the spaces below to rate the student's performance of the above assignment sheet tasks by giving him or her a 3 to indicate the student has mastered the tasks; a 2 to indicate that the student needs supervision to perform the tasks; a 1 to indicate that the student has not mastered the tasks; or N to indicate that the student lacked the experience or knowledge to perform the tasks. The student's rating will serve as his or her final evaluation for Competency B2.)

___ 3___ 2___ 1___ N

MODULE: INTRODUCTION TO AUTO MECHANICS

WRITING A REPAIR ORDER

Instructions: Either on the board or a separate sheet of paper, the instructor will list an automotive repair. Fill out the repair order on the following page for the instructor's repair.

(NOTE: Use the spaces below to rate the student's performance of the above assignment sheet tasks by giving him or her a 3 to indicate the student has mastered the tasks; a 2 to indicate that the student needs supervision to perform the tasks; a 1 to indicate that the student has not mastered the tasks; or N to indicate that the student lacked the experience or knowledge to perform the tasks. The student's rating will serve as his or her final evaluation for Competency B1.)

___ 3___ 2___ 1___ N

AS2-L1-UVI

SMITH BROTHERS AUTO REPAIR

CUSTOMER'S NAME _____ DATE _____ INVOICE NUMBER 546387

ADDRESS _____ PHONE _____

VEHICLE YEAR/MAKE _____ VEHICLE MODEL _____ MOTOR/VIN NUMBER _____

SERVICE WRITER _____ REPAIR TECHNICIAN _____

CUSTOMER AUTHORIZATION SIGNATURE _____

CUSTOMER COMPLAINT

_____

_____

_____

_____

_____

_____

	ESTIMATED	ACTUAL
LABOR PROCEDURES AND COSTS		
OUTSIDE LABOR PROCEDURES AND COSTS		
TOTAL LABOR COSTS		
PARTS COSTS QTY. PART NO. DESCRIPTION		
TOTAL PARTS COSTS		
LABOR TOTAL		
PARTS TOTAL		
TAX		
GRAND TOTAL		

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MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT VI: SHOP OPERATION

LESSON 2: SERVICE AND LABOR MANUALS

I. Different sources of vehicle repair procedures

(NOTE: The automotive technician has always needed access to proper repair service manuals. In recent years, vehicles have become so technologically advanced that service and repair manuals are used on nearly every job. These manuals contain vital information on service procedures [step by step instructions to a task] and specifications of all types. Service and repair manuals are available in the following forms.)

A. Manufacturer's service manuals contain the specifications and procedures applicable to a particular vehicle. For this reason, they are comprehensive and probably the best source of information for a particular vehicle. However, due to the size and cost of these manuals (and because one manual covers usually one vehicle for one model year), it is impractical for the general independent repair shop to have a full complement of manufacturer's manuals.

B. Professional general service manuals are widely used by independent repair shops because one manual will contain information for most domestic or foreign cars produced over several years.

C. After-market specialty manuals are often sold at bookstores and may cover one model of vehicle produced over several years. These manuals are written for the layman as well as the service technician and are, therefore, popular with the "do-it-yourself" individual.

D. Both the automobile manufacturers and publishers of professional repair manuals make service manuals available on microfiche, a small piece of film, which contains print that is greatly reduced in size. Microfiche allows a great deal of information to be stored in a very small space. A microfiche machine is used to read the microfiche. The microfiche machine is like a projector, which displays a magnified image of the microfiche on a screen.

E. The computer disc is one of the latest method used to store service information. The disc, which is relatively small, can store a great deal of information and display the information on a screen. Computer discs are convenient and save a great deal of space.

MODULE: INTRODUCTION TO AUTO MECHANICS

OBTAINING REPAIR PROCEDURE INFORMATION FROM A SHOP REPAIR MANUAL

Instructions: Either on the board or a separate sheet of paper, the instructor will list two automotive repairs. Locate procedures for performing the repairs in the appropriate repair manual and answer the questions below.

1. What is the first repair listed by the instructor?

2. What is the name of the repair manual in which the procedure for performing the first repair can be found? On what pages of the repair manual can the procedure be found?

3. What is the second repair listed by the instructor?

4. What is the name of the repair manual in which the procedure for performing the second repair can be found? On what pages of the repair manual can the procedure be found?

(NOTE: Use the spaces below to rate the student's performance of the above assignment sheet tasks by giving him or her a 3 to indicate the student has mastered the tasks; a 2 to indicate that the student needs supervision to perform the tasks; a 1 to indicate that the student has not mastered the tasks; or N to indicate that the student lacked the experience or knowledge to perform the tasks. The student's rating will serve as his or her final evaluation for Competency B3.)

____ 3____ 2____ 1____ N

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT VI: SHOP OPERATION

LESSON 3: SHOP CLEANLINESS AND MAINTENANCE

I. The importance of maintaining cleanliness and orderliness in the shop

A. A clean shop environment, one that is free from grease and oily spills, reduces the hazards of slipping, soiling clothing, and also protects the car from grease or damage to paint.

B. An orderly shop with clear pathways to exits offers protection and allows employees easy access to exits. It should also be noted that, due to regulations of the EPA and local Fire Codes, the local Fire Marshall is empowered to insist upon an orderly, uncluttered, and safe shop area.

C. By keeping tools, equipment, and supplies well organized, the technician will not have to spend time looking for tools and supplies and, thus, can work with greater efficiency.

D. A clean and orderly shop is the mark of competent professionals, and will create a secure feeling on the part of the customer. A clean and orderly shop promotes business growth.

II. Procedures for maintaining and repairing the shop facilities and equipment

(NOTE: A well-maintained facility makes a positive impression on the general public. Well maintained equipment can be expected to perform reliably for many years.)

A. Periodically check to see if the shop building needs paint, roofing, siding, doors, and windows.

B. Maintain the grounds. Grass should be frequently mowed and shrubs trimmed. Trash should be picked up daily.

C. Scrub floors daily. Repair work creates a great deal of grease and dirt, which should not be allowed to accumulate.

D. Maintenance of shop equipment

(NOTE: A regular schedule of maintenance should be set up based on the recommendations of the equipment manufacturer.)

1. Gas calibration of exhaust analyzers must occur weekly. The analyzer must be normally calibrated before each use.

2. Dirt and dust must be wiped from the electronic testers. The test leads should be inspected and carefully wrapped up after each use.

3. Front-end alignment machines and wheel balancers should be calibrated. This is usually done annually.

4. Water should be drained from the air compressor daily. The compressor should also be inspected daily.

5. Air hoses and drop lights should be inspected after each use.

6. Air-powered tools should be lubricated at least once a week.

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT VI: SHOP OPERATION

UNIT VI TEST

PART I. COMMUNICATING WITH CUSTOMERS AND WRITING REPAIR ORDERS

SECTION A. **Read the statements below. Place a T or F in the blank beside each statement to indicate whether it is true or false.**

____ 1. More workers are fired because of their inability to get along with others than their lack of technical knowledge.

____ 2. If the mechanic is frustrated, he or she should show his frustrations when greeting customers.

____ 3. Listening to a customer complaint is a waste of time.

____ 4. Verifying a diagnosis ensures the mechanic is perceiving the problem correctly.

____ 5. If an unexpected problem is found during an inspection, the technician should repair the problem before consulting the owner.

____ 6. If a customer is unwilling to have extra repairs done, the technician should perform the repairs anyway.

____ 7. Greasy hand prints are a sign of a careless technician.

____ 8. The general public usually has positive feelings about auto repair shops.

____ 9. The home and work phone number of customer should not appear on the work order.

____ 10. The technician's initials should not appear on the work order.

____ 11. Sales tax should be listed on the work order.

(NOTE: The student must obtain a minimum score of ____ on Part I of the Unit VI Test in order to receive an evaluation for Competency B1.)

PART II. ESTIMATING WORK TIME AND ORDERING PARTS

SECTION A. **Read the statements below. Place a T or F in the blank beside each statement to indicate whether it is true or false.**

____ 12. Parts and labor estimating guides are used to determine the availability of auto parts.

____ 13. Shops use the parts and labor estimating guide to calculate labor charges.

____ 14. Vehicle identification numbers do not list model years on cars made before 1980.

____ 15. Tail light lens are the best place to check the model year of a vehicle.

____ 16. Engine decals often provide useful information about the vehicle.

____ 17. When the technician orders rebuilt parts, he or she must usually return the old parts to the manufacturer.

____ 18. Most electrical parts can be returned if they are not needed.

(NOTE: The student must obtain a minimum score of ____ on Part II of the Unit VI Test in order to receive an evaluation for Competency B2.)

PART III. MAINTAINING CLEAN AND ORDERLY WORK HABITS

SECTION A. **Read the statements below. Place a T or F in the blank beside each statement to indicate whether it is true or false.**

____ 19. A clean shop provides a safe environment for work.

____ 20. Fire marshals can insist on an orderly, uncluttered and safe shop.

____ 21. An organized shop can lower efficiency.

____ 22. A well-maintained shop makes a positive impression on people who pass by.

____ 23. Scrubbing the floor daily helps to prevent people from slipping.

____ 24. Water should be drained from the air compressor daily.

____ 25. Air hoses and drop lights should be inspected prior to use.

____ 26. Fender covers should be used only during repairs on new cars.

____ 27. Always test the brakes before moving a car.

____ 28. The technician should keep his or her hands as clean as reasonably possible while making repairs.

(NOTE: The student's score on the Unit VI Test will be his or her final evaluation for Competency B4. A score between ____ and ____ = 3; a score between ____ and ____ = 2; a sore between ____ and ____ = 1, and a score lower than ____ = N.)

ANSWERS TO UNIT VI TEST

1. t
2. f
3. f
4. t
5. f
6. f
7. t
8. f
9. f
10. f
11. t
12. f
13. t
14. f
15. f
16. t
17. t
18. f
19. t
20. t
21. f
22. t
23. t
24. t
25. t
26. f
27. t
28. t

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT VII: CAREERS IN AUTO MECHANICS

UNIT OBJECTIVES

After completing this unit, the student should be able to identify the basic functions of various systems of the automobile and identify the duties and career opportunities of auto mechanics. The student will demonstrate mastery of the material by achieving a score of _____ on the unit test.

SPECIFIC OBJECTIVES

After completing the lessons in this unit, the student should be able to:

Lesson 1.

I. Identify the eight service areas of automotive mechanics and the automotive components included in each (Competency C1, Part I of the Unit VII Test).

Lesson 2.

I. Identify the career opportunities directly related to the auto mechanics field (Competency C2, Part II of the Unit VII Test).

II. Identify the different career opportunities indirectly related to auto mechanics (Competency C2, Part II of the Unit VII Test).

III. Identify some of the typical duties of the automobile mechanic (Competency C2, Part II of the Unit VII Test).

IV. Identify the various methods by which the automotive mechanic is paid (Competency C2, Part II of the Unit VII Test).

V. Identify the difference between a union and a non-union shop (Competency C2, Part II of the Unit VII Test).

VI. Identify the importance of honesty to the success of the automotive mechanic (Competency C2, Part II of the Unit VII Test).

ASE TASKS COVERED IN THIS UNIT

I. Only material that is preliminary to ASE tasks appears in this unit; therefore, no ASE tasks are covered directly.

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT VII: CAREERS IN AUTO MECHANICS

CONTENTS OF THIS UNIT

A. Objective sheet

B. References

C. Lesson plans

1. Lesson 1: AUTOMOTIVE MECHANICAL AREAS

   a. Information outline

2. Lesson 2: WORKING IN THE AUTO REPAIR FIELD

   a. Information outline

D. Unit test

E. Answers to unit test

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MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT VII: AUTOMOTIVE CERTIFICATION AND CAREERS

LESSON 1: AUTOMOTIVE MECHANICAL AREAS

I. The National Institute for Automotive Service Excellence, more commonly known as ASE, divides the automotive mechanics field into eight service areas. The technician must pass an ASE test before receiving certification in any of these areas. The technician receives a badge indicating certification in a specific service area.

(NOTE: Below is a very general overview of the ASE service areas and the components they involve. In the Missouri Auto Mechanics Curriculum Guide, an entire module is developed to each ASE service area. In these modules service and repair of components as well as their principles of operation, are covered in extensive detail.)

A. ASE identifies electrical systems as an individual service area. The electrical systems service area involves the components listed below.

1. Battery--Device which stores and provides electrical power for the vehicle.

2. Charging system--Electrical components that create electrical power for the vehicle.

3. The starter motor and starter circuit--Components that crank the engine.

4. Lighting system--Group of lights that help the driver to see at night (head lights) and that provide convenience (such as a dome light).

5. Gauges and accessories--Group of electrical components that provide the driver with information and convenience (the gas gauge, brake warning light, and radio, for example).

B. ASE identifies engine performance as an individual service area. The engine performance service area involves the components listed below.

1. The ignition system--Components that ignite the fuel and air mixture at the proper time to create maximum power and minimum emissions.

2. The fuel system--Components that transfer fuel from the fuel tank to the engine cylinders in the proper amounts so as to create maximum power and minimum emissions.

3. The exhaust system--Components that remove combustion by-products from the engine.

4. The emission control system--Components that reduce the amount of harmful gases emitted from the vehicle.

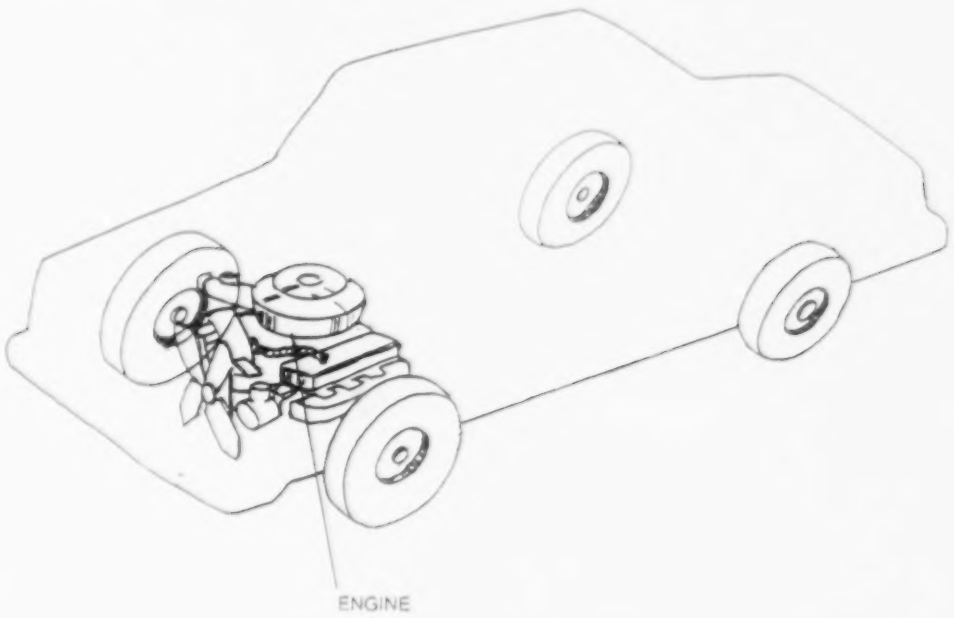
C. ASE identifies engine repair as an individual service area. The engine repair service area involves the components listed below.

1. Cylinder heads--The foundation of the valve train.

2. Valve train--Components that open and close the cylinder, allowing the air and fuel mixture in and the exhaust gases out.

3. Short block assembly--Those components that are found in or on the engine block.

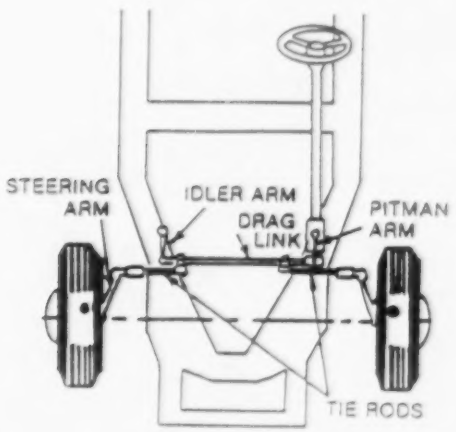
4. Cooling system--Components (such as the radiator and water pump) that maintain proper engine temperature.



D. ASE identifies suspension and steering as an individual service area. The suspension and steering service area involves the components listed below.

1. Steering system--Components that allow the driver to control the direction of the vehicle.

2. Suspension system--Components that reduce the number of shocks felt by the vehicle passengers and that allow the vehicle to maintain contact with the road.

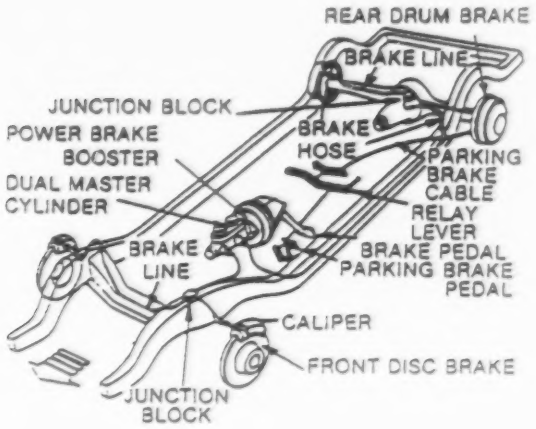


E. ASE identifies brakes as an individual service area. The brakes service area involves the components listed below.

1. Hydraulic system--Components (such as the brake lines and master cylinder) that transfer power from the brake pedal to either disc or drum brakes.

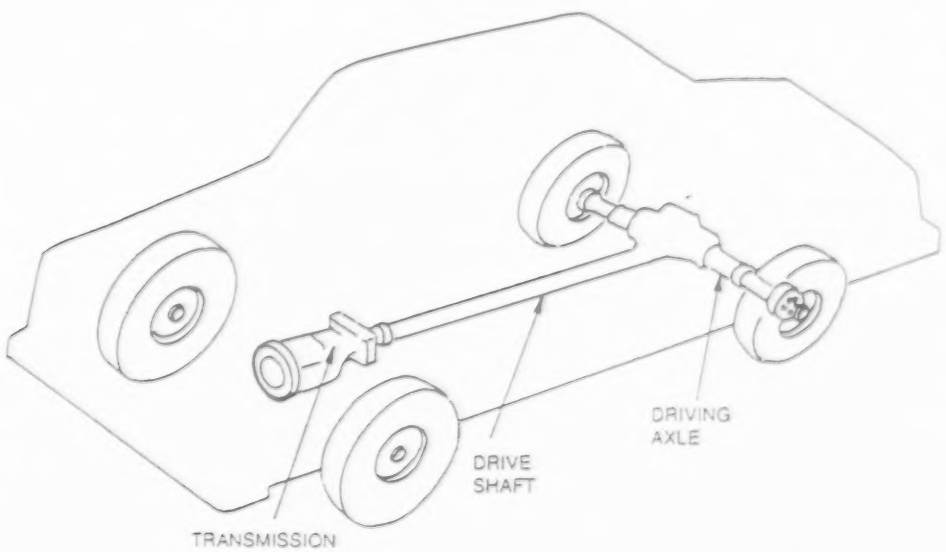
2. Mechanical system--Components (such as discs and pads or drums and shoes) that create the friction required to stop the vehicle.

3. Electronic system--Components that notify the driver of a failure in the brake system. In anti-lock brake systems, electrical system components work to prevent tire skidding.



F. ASE identifies manual drive train as an individual service area. The manual drive train and axles service area includes the manual drive train, which is a series of components that transfer power from the engine to the wheels. Manual drive trains are controlled directly by the driver through the use of a clutch and gear shift.

G. ASE identifies automatic transmission as an individual service area. The automatic transmission involves the drive train, which is a series of components that transfer power from the engine to the wheels. In automatic transmissions, drive trains are controlled by a complex hydraulic system rather than the driver.



H. ASE identifies heating and air conditioning as an individual service area. The heating and air conditioning service includes all components related to the vehicle's heating and air conditioning system.

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT VII: AUTOMOTIVE COMPONENTS AND CAREERS

LESSON 2: WORKING IN THE AUTO REPAIR FIELD

I. Listed below are various career opportunities directly related to auto mechanics.

(NOTE: Many job opportunities await the graduate of an automotive technology program. It is estimated that one of every 10 occupations in the United States is directly or indirectly related to the production and maintenance of the automobile.)

A. Automobile technician

B. Automobile technician's apprentice

C. Supervisor of a repair shop garage

D. Exhaust and emissions technician

E. Tune-up technician

F. Automotive repair service writer

G. Mechanical unit repairer

H. Technician in automotive manufacturing plants

I. Air conditioning technician

J. Gasoline engine technician

K. Teacher or trainer

(NOTE: Many graduates of automotive mechanics programs may be qualified to pursue a career as a teacher or trainer in the automotive field. In many cases, a graduate of an auto mechanics program would need little or no extra training to secure an entry-level teaching or training position.)

L. Diesel technician

M. Bus inspector

N. Tractor mechanic

O. Parts salvager

II. Listed below are various career opportunities indirectly related to auto mechanics.

A. Farm equipment technician

B. Aircraft technician

C. Office equipment service technician/service representative

D. Machinist apprentice

E. Air conditioning and heating service apprentice

F. Industrial machine maintenance technician

G. Small engine technician

H. Marine equipment technician

I. Motorcycle technician

III. Listed below are some typical duties of an automotive technician.

A. The technician repairs, overhauls, and services automobiles, buses, trucks, and other vehicles.

B. The technician examines vehicles and discusses the nature and extent of problems with customers or automobile repair service estimators.

C. The technician plans work procedures, using charts, technical manuals, and his or her experience.

D. The technician raises vehicles, using hydraulic jack or hoist, to gain access to mechanical units bolted to underside of vehicle.

E. The technician removes units, such as the engine, transmission, or differential.

F. The technician disassembles rods, gears, valves, and bearings.

G. The technician overhauls or replaces carburetors, blowers, and generators.

H. The technician rewires ignition systems, lights, and instrument panels.

I. The technician relines and adjusts brakes, aligns front end, repairs or replaces shock absorbers, and solders leaks in radiator.

J. The technician replaces and adjusts headlights, and installs and repairs accessories, such as radios, heaters, mirrors, and windshield wipers.

IV. The various methods by which automobile mechanics are paid

A. The technician's pay is often based on the flat-rate system. The flat-rate system means that, regardless of the amount of time the mechanic spent on a particular repair, he or she is paid by multiplying the hourly wage by the time listed for that job in a factory flat-rate manual or an aftermarket labor time guide. (These guides are sometimes called parts and labor estimating guides. See Unit VI of this module for further discussion on these manuals.) In the flat-rate system, the technician is paid basically the same whether one hour or four hours were spent on a job. Obviously this can work either to the advantage or disadvantage of the technician.

B. If the technician is on salary, he or she will be paid a set amount of money (usually 40 hours per week), regardless of the volume of work performed.

C. The half-labor method of payment is seldom encountered in the auto mechanics industry. In the half-labor system, the technician is paid a portion (usually 1/2) of the labor charge on the repair invoice. If, for example, the shop labor rate is $18 per hour (hours based on the time listed in a flat-rate or labor time guide manual), the mechanic would be earning $9 per paid hour.

V. If a shop has unionized employees, the technicians will be encouraged to join the union. Upon joining the union, the technician will have membership fees deducted from his or her salary. The technician will be subject to the union's rules regarding salary and other issues. (For example, the technician may be required to work for two years as an apprentice before advancing to the journeyman level.) The union can help employees negotiate with their employers regarding salaries and working conditions.

VI. Honesty is critical to the success of the automotive technician. Few shops can or will tolerate a technician that steals supplies, tools, or money from the shop. Since nearly all technicians must purchase their own hand tools (which can cost over $10,000), it is very important for all technicians to respect the tools and property of others. Integrity of job performance will ensure a low rate of come-backs (cars returned with complaint) and will thus ensure the technician's ability to generate income. Customers appreciate friendly, competent, and honest service. A technician with a reputation for providing such service enjoys the respect of his or her customers, employer, and fellow technicians.

MODULE: INTRODUCTION TO AUTO MECHANICS

UNIT VII: CAREERS IN AUTO MECHANICS

UNIT VII TEST

PART I. BASIC AUTOMOTIVE COMPONENTS

SECTION A. **Read the statements below. Place a T or F in the blank beside each statement to indicate whether it is true or false.**

____ 1. The brake warning light is an example of electrical accessories.

____ 2. The function of a vehicle's ignition system is to cool the engine.

____ 3. The emission control system is simply another term for the exhaust system.

____ 4. Cylinder heads are the foundation of the valve train.

____ 5. The vehicle's water pump is part of the accessories system.

____ 6. The valve train transfers power from a vehicle's engine to its wheels.

____ 7. An important function of the suspension is to keep the vehicle in contact with the road.

____ 8. Most brake systems involve hydraulic and mechanical activity.

____ 9. Anti-lock brake systems involve the use of electrical systems.

____ 10. In automatic transmissions, the drive train is directly controlled by the driver.

(NOTE: The student's score on the Unit VII Test will be his or her final evaluation for Competency C1. A score between ____ and ____ = 3; a score between ____ and ____ = 2; a sore between ____ and ____ = 1, and a score lower than ____ = N.)

PART II. CAREER OPPORTUNITIES AND DUTIES OF THE TECHNICIAN

SECTION A. **Read the statements below. Place a T or F in the blank beside each statement to indicate whether it is true or false.**

____ 11. As a direct result of auto mechanics training, a person could pursue a career as a bus inspector.

____ 12. Auto mechanics training may indirectly help an individual pursue a career as an aircraft technician.

____ 13. A technician who is paid by the flat-rate system is paid according to the number of hours he or she actually spends on a repair.

____ 14. The half-labor method of payment is very common in the auto mechanics field.

____ 15. The flat-rate system is based upon a factory flat-rate manual or an aftermarket labor time guide.

____ 16. A salaried technician receives a set salary regardless of how much work he or she performs.

____ 17. Union members must pay membership fees.

____ 18. A union helps employees to negotiate salaries with their employers.

____ 19. Technicians should not emphasize profit at the expense of honesty.

____ 20. Technicians must purchase their own hand tools, which can cost over $10,000.

(NOTE: The student's score on the Unit VII Test will be his or her final evaluation for Competency C2. A score between ____ and ____ = 3; a score between ____ and ____ = 2; a sore between ____ and ____ = 1, and a score lower than ____ = N.)

ANSWERS TO UNIT VII TEST

1. t
2. f
3. f
4. t
5. f
6. f
7. t
8. t
9. t
10. f
11. t
12. t
13. f
14. f
15. t
16. t
17. t
18. t
19. t
20. t